The Electrical Review

Vol. LXXVIII. No. 1992. [All Rights Reserved.] JANUARY 28, 1916. [Registered at G.P.O. as a Newspaper and Canadian Magazine rate of postage.] PRICE FOURPENCE.

LONDON: PUBLISHING OFFICE, 4, LUDGATE HILL, E.C. SUBSCRIPTION per annum, Postage inclusive, in Great Britain, £1 1s. 8d.; Canada, £1 3s. 10d. ($5.80); to all other countries, 30s.—NEW YORK: D. VAN NOSTRAND CO., 23, Park Place, New York City. TORONTO, ONT.: WM. DAWSON & SONS, LTD., Manning Chambers. PARIS: BOYVEAU & CHEVILLET, Librairie Etrangère, 22, Rue de la Banque.
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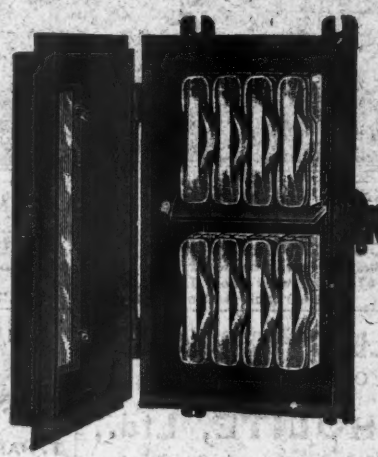

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THE

ELECTRICAL REVIEW.

VOL. LXXVIII. JANUARY 28, 1916. No. 1,992.

ELECTRICAL REVIEW.

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The "Electrical Review" is the recognised medium of the Electrical Trades, and has by far the Largest Circulation of any Electrical Industrial Paper in Great Britain.

Subscription Rates.—Per annum, postage inclusive, in Great Britain, £1 1s. 4d.; Canada, £1 3s. 10d. ($5.80). To all other countries, £1 10s.

FOREIGN AGENTS:

ADELAIDE: Messrs. Atkinson & Co., Gresham Street.

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Cheques and Postal Orders (on Chief Office, London) to be made payable to THE ELECTRICAL REVIEW, and crossed "London City and Midland Bank, Newgate Street Branch."

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IN view of the recent Increase in the Postal Charges, our Subscription Rates for Great Britain and Canada will until further notice be increased to £1 1s. 8d. and £1 3s. 10d. respectively.

TRADING WITH THE ENEMY.

THE introduction of the Trading with the Enemy (Amendment) (No. 2) Bill has once more brought into prominence certain vexed questions as to companies which consist in the main of enemy shareholders. The Government has been accused of delaying action in connection with the matter, and it has been stated that the early Acts ought to have more drastically dealt with the situation. The subject, however, is hedged about with difficulties of no ordinary kind, and in some respects those difficulties have been less understood by the legislative mind than by the mind of business men, who have been "up against" enemy-owned firms and companies ever since the outbreak of war. The legislative mind has viewed the matter perhaps too coldly and unsuspectingly, regarding it purely in its legal aspects; the business man, on the other hand, has been in some cases too ready to jump at conclusions, so obnoxious has it been to him to have relations with those who belonged to a race with so vile a record as Germany has written in blood and lust during these eighteen months. We can conceive, however, of circumstances under which the business of a company may well be advantageous to this country, although the majority of its shares are held in Germany and Austria, and it would not therefore be wise to say that a company must be wound up merely because some of its shareholders are Germans; but there is no reason for permitting concerns which are practically entirely German-owned to "carry on," making profits during the war, and keeping the way open for the enemy's "after-the-war trade."

It is most desirable that the matter be taken in hand, and the new Bill will be welcomed by everybody who has observed the extent to which German ownership and control have spread amongst us, notwithstanding the fact that our own Patents legislation has been responsible for much German capital being put into British factories. The principle of the Patents Act was not to enable the foreigner to get a firmer grip here, but to assist the development of British industries within these islands, and when the principle of "limited liability" was established some 60 years ago, it was never intended to enure for the benefit of countries which are at war with England.

The fact that a company is what lawyers call a "separate entity," as apart from the shareholders, should not be allowed to stand in the way if exigency demands that its operations be restricted. Under the law, as it now stands, the dividends on shares held in English companies by alien enemies may be paid to the custodian of enemy profits; but the company may still carry on in war time. The goodwill, which may belong almost entirely to alien enemies, is thus maintained, and war profits might even accrue. The profits thus accumulating might be of great use to the enemy at the end of the war. In particular, the existing law as to ownership of a ship is playing right into enemy hands. No alien can own a British ship, but two Germans can form a company, and that company can own a ship.

The Bill introduced by the Solicitor-General proposes to redress these evils. The Board of Trade is empowered to make inquiries. If satisfied that a business carried on in the United Kingdom is, by reason of enemy nationality or enemy association of those who carry it on, conducted wholly or mainly for the benefit of subjects of enemy states, then the Board may make an order either prohibiting the carrying on of the business during the war, or directing it to be wound up. If the business is for the national benefit, the Board of Trade may allow it to be carried on. If it

is small and insignificant, or if its closure would involve unnecessary hardship, the Board will still be able to exercise its discretion. It will be observed that almost everything depends upon the pursuance of an energetic and thorough policy by the Board of Trade. When once this Bill becomes an Act the Board will have all the powers that it will need to deal with the matter, and we may be sure that if those powers are not put into force, not only the business world at home, but our Colonial statesmen who have worked so hard to eliminate German influence, will want to know why. In distributing the assets of a company which is to be wound up, preference will be given to British and friendly creditors over those who are enemy creditors. If the company has assets in the enemy country, regard will be had to the fact that those assets will probably be applied for the benefit of creditors in that country.

In accordance with the best traditions of English justice the powers given to the Board of Trade err on the side of leniency to the alien enemy. In a winding up the sum due to an enemy shareholder will not, of course, be paid over to him, but will be held until peace is declared, and until it is found how British property in enemy countries is being dealt with.

That it will be necessary to establish such a fund was made plain by Mr. Cave, when he told the House of an Englishman who, when war was declared, was carrying on business in the Fatherland. His business was placed under a controller, he himself was interned. In January, 1915, he was informed that he had nothing further to do with it, that it had become a German business; but that he, as manager, would still be responsible for its debts! But the most unkindest cut of all was that all the profits would be invested in the German War Loan! If this represents the way in which Germany is dealing with English property, it seems to us that the Government would be fully justified in confiscating all German property now in England. But that is not our way, though we may not find it impossible to have a progressive policy in this as in other connections, as the war takes on new phases. Under this new Bill the Government are going to hold on to German property until some time after the end of the war. It will be held in bond as security for fair dealing with property now owned by Englishmen on enemy soil.

The Bill was received with acclamation by the House of Commons, and that is not surprising, for enough has happened in the war to show that Germany is determined to show no mercy to England or to anything English; and the Government should do everything within their power, either through the medium of this Bill or in any other way, to enable us to carry on as far as possible without German companies, German shareholders, or German goods, when peace is once more restored. Acts such as this may go part way in assisting us to that end, but as we have repeatedly shown, there are many other respects in which we have got to set our house in order before Germany will be a permanently beaten commercial and industrial nation. We must not expect too much from Acts of Parliament—merit still counts and always will, and we must improve both the individual and the combined efficiency throughout the nation if we wish to hold our own, or to regain such part of it as we had lost.

Electric Railways.

Quite unexpectedly—for our thoughts for long have been directed elsewhere—a flood of information on the subject of heavy electric traction and electric locomotives has been let loose upon us, by Mr. H. M. Hobart and Mr. F. W. Carter respectively. Elsewhere in this issue we review the contents of Mr. Hobart's masterly lecture, which conclusively demonstrates that the steam locomotive, having reached its physical limits, has been beaten almost to a standstill by its younger rival. "Youth will be served," in the future as in the past; the steam locomotive for just over a century has done magnificent work, of incalculable benefit to mankind—it has deserved well at our hands, and will continue to do so for many years to come. But its best days are over, and, even in this country, where coal is abundant and water-power scarce, the inherent advantages of its electrical rival have compelled recognition, whilst in countries blessed with water-power and peace, the electrification of steam railways is rapidly advancing.

Mr. Hobart's lecture was devoted mainly to the marshalling of facts and the deductions that could be based upon them, leading up to the triumphant conclusion that electrification on an extended scale was imminent, preferably on the high-pressure direct-current system; Mr. Carter's paper, on the other hand, dealt with the design and performance of the numerous types of locomotives which have been evolved in the endeavour to find a satisfactory method of transmitting the power from the motors to the driving wheels. It is a curious fact, emphasised by Mr. Aspinall in the discussion, and later by Dr. Parshall, that the outstanding problem in the design of electric locomotives is a purely mechanical one, that of communicating the rotary motion of the motor armature to the revolving wheels—a simple enough matter on the surface, but in reality so complicated by considerations of space, weight, velocity ratio, spring suspension, flexibility of frame, smoothness of running, height of centre of gravity, and other important factors, that it remains up to the present without a satisfactory solution. Mr. Carter has applied the resources of mathematics to certain aspects of the question, particularly in connection with the "nosing" tendency of some types of locomotive, due to the interaction of the coned wheel treads, the flanges, and the rails, and by original methods has succeeded in dissecting the problem into its component parts and providing an apparently sound theory by means of which this objectionable proclivity can be restrained. Two very important facts which he has brought to light, on the basis of exhaustive tests of train resistance that were carried out 10 years ago, are that the tractive resistance of a train of coaches is a straight-line function of the number of coaches, at any given speed; also, the additional tractive resistance per additional coach is a straight-line function of the speed.

In view of the amount of work that has been expended on this subject, and the anomalous results previously obtained, it is extraordinary that these facts—which are now conclusively demonstrated—should have eluded discovery for so long a period, and the author is to be congratulated on the result of his examination of these data.

Both authors are well known to be strenuous upholders of the direct-current system as opposed to single-phase, and they have not failed to indicate the trend of their convictions in their latest writings; Mr. Hobart reminds us that many years ago he predicted the ultimate victory of the high-pressure D.C. system, and Mr. Carter ascribes the evolution of the side-rod "cranky" type of locomotive to the necessities of the single-phase system, which also is credited with resonance tendencies. Naturally, the supporters of S.P. likewise did not fail to repel the aspersions cast upon their *protégé*, which certainly is not yet by any means out of the running. But the controversy nowadays does not assume an acute form, and the amenities of debate were preserved. No new data regarding the commercial working of the single-phase system were forthcoming, as Col. Crompton regretfully remarked, with reference to Mr. Philip Dawson's contribution to the discussion; but it is interesting to record, as showing that Mr. Dawson preserves an open mind on the subject, that he recently approved of the high-pressure D.C. system as undoubtedly the right thing for a British railway in connection with which he was consulted.

Doubtless there is room for both systems, and both are being extended; but it seems obvious that the successful adoption of continually higher voltages on D.C. systems tends to rob the S.P. system of one of its most tangible advantages. Mr. Aspinall stated that the experimental 3,000-volt D.C. system on the L. & Y. Railway had worked successfully from the commencement.

Mr. Merz considered the United Kingdom particularly favourable to the development of electric traction on railways, and stated that the trial runs on the North-Eastern mineral line had proved highly satisfactory. It is generally agreed that for moderate speeds the existing designs of electric locomotive serve very well, but for express passenger service a satisfactory design is still awaited.

Those Consuls Again.

The shortcomings of our Consular service, from the trade point of view, are becoming a popular theme—perhaps now we shall see something done. Speaking at a meeting of the Commercial Committee of the House of Commons, of which he is honorary secretary, Mr. Louis Sinclair, in an address to the Employers' Parliamentary Association, referred to those shortcomings, and said that more money should be spent upon the Consular trade service. Some of of us have been saying such things almost as long as we can remember. If the Commercial Committee of the House of Commons is worth its salt it will use its influence to secure that result. Particularly interesting are the remarks of the Earl of Rosebery on the same question and on another matter too. In an address to the Rotary Club, Edinburgh, last week, he said that it would be a mistake for business men to seek, or to reckon upon, any assistance from the Government for commercial enterprises after the war. There were, however, two points on which they should be prepared to disregard preconceived notions. They would have to reconsider the question of tariffs, and many of our previous formulas by which we could not be hampered in the prosecution of a successful foreign trade. This remark, be it noted, comes from one who, under other conditions, said that nationally we must stand or fall by Free Trade. The altered situation brought about by the war has put many people's views into the melting pot, but his lordship's attitude forms one of the most conspicuous examples of the willingness of eminent men to scrap their "preconceived notions." Lord Rosebery's second point was stated thus:—"The Foreign Office have always had the greatest antipathy to their Consular agents engaging in promoting commerce of particular firms in foreign countries. I think the *laissez aller* policy will have to be abandoned, and we shall have to sanction the interference of our Consular agents to promote our commerce in foreign countries." With all due deference to his lordship, we would say that it seems to us that in the reform of our Consular service for the good of commercial enterprises, business men have every reason to reckon upon receiving assistance from the Government.

In our opinion, the Foreign Office is far more to blame than any other department for our national shortcomings in this connection. As matters stand, with a few notable exceptions, we receive far greater assistance from our few Trade Commissioners than from all the Consuls, and we should like to see the Board of Trade's activities extended. The Board never really has had an opportunity of showing, on a proper scale, what it can do in legitimate ways through the medium of such representatives. "*Sanction interference*" indeed! Yet we are inclined to think that Lord Rosebery is one of those who really ought to know. Was he not Foreign Secretary once—and for a brief spell Prime Minister too?

"Promoting the commerce of *particular firms*" it might be right to object to under some circumstances, but a Teuton would have no scruples on that point, so long as the business went to Germany as the result of his Consular activity. But what about the commerce of our *nation* as a whole? Has the Foreign Office an "antipathy" to the fostering of that? We are very much afraid that that is how it has been too frequently in the past. Yet there is ground for hoping that even the Foreign Office is now willing to do something to assist British traders. We are grateful for its decision to appoint commercial attachés at Buenos Aires, Monte Video, and Rio de Janeiro, a consul and a vice-consul being called from other duties to fill these new offices. The appointments have been made, says the announcement, in consequence of the Secretary of State for Foreign Affairs "having decided to give further assistance towards the promotion of British trade in South America." If this is a sign of the times, we are profoundly thankful for it.

Those who are doubtful as to whether Government Departments are able to assist in the development of national trades might do worse than read the report which we give on another page concerning the first year's work of the U.S. Bureau of Foreign and Domestic Commerce. It tells, it is true, of some of the difficulties that America is "up against" in connection with export trade, but it quotes a number of definite practical results of the Bureau's recent efforts. The reference to the vote of $100,000 for new commercial attaché service, and the need for extending such vote and service, should be noted.

Copper.

Copper prices continue to advance steadily, and it is generally believed in the trade that the recent official pronouncement regarding maximum prices is not to be taken seriously. At any rate, consumers report that they are unable to obtain supplies from the Government at the price fixed by them of £100 for refined material, and after waiting in vain in an attempt to secure relief from this direction have been forced into the market, where competitive buying has naturally forced rates still higher. At the present time it is exceedingly difficult to obtain copper at any price, for the leading producers are sold out for months ahead, and are only willing to make prices for very small lots for prompt or early shipment, while holding off altogether in respect of important distant business. On the top of this, stocks here are going down, and refiners are treating metal which they have discarded for years past, for the simple reason that they are unable to obtain anything else. The enormous margin, too, between the prices of standard copper and refined makes it possible for them to treat the former at a profit, whereas for a long period they have been unable to handle this class of material, and to make a living out of it. The American position shows not the least sign of abating in its strength, and reports to hand from America speak of a copper "famine." Certainly the leading selling agents in America are unanimous in declaring that this condition of affairs has now come to pass, there being hardly any January, February, March or April copper now to be obtained except as a favour. There seems some truth, too, in the statement which emanates from leading producers that there is not sufficient copper to go round, and certainly consumers in need of supplies have been paying enormous prices. Refinery capacity, although going to the fullest extent, is unable to turn out the quantities of material required by the trade, while there seems to be a glut of raw copper, for the mines and furnaces are turning out more material than the refineries can handle. How long this state of affairs can continue is a matter of conjecture, but there can certainly be no relief until war conditions are modified, and we seem likely, therefore, to drift on for months before any definite lead is given. According to statistics just available, the United States output of refined copper from native and imported raw material broke all records—at 735,000 tons, against 684,000 tons in 1914.

British Electrical Exports and Imports during 1915.

Elsewhere in this issue we publish a graphic summary of British electrical export and import business during the year 1915, which will be of considerable interest to our readers in view of the exceedingly difficult period through which this country, in common with others, has been passing.

Black as has been the outlook, from the point of view of British trade during the year, it cannot be said that the clouds show any real signs of rolling away, and our consolation, such as it is, must be gathered from the excellent fight which the home electrical manufacturer has been able to put up with a view to retaining overseas trade, despite our concentration on munition making and war supplies.

Although the total value of our electrical exports was naturally much less than during the last few years, it must be remembered that 1915 was devoid of bulk submarine telegraphic exports.

America has usurped the place of Germany as an importer into this country, as was expected, under the conditions prevailing, and the only blot in the import returns for the year, appears to be the fact that it should have been necessary for us to purchase £125,000 worth of lamps and parts from Holland, material which is produced by female labour, and could, therefore, have been produced here, had the manufacturing facilities existed.

MUNICIPAL ELECTRICITY SUPPLY AT JOHANNESBURG.

By R. TURNBULL MAWDESLEY.

(*Continued from page* 91.)

THERE are four Peebles-La Cour motor-converters installed in the principal generating station, two of 750-KW. capacity and two of 1,250 KW. made by Messrs. Bruce Peebles and Co., Edinburgh, all of which are in constant service. As previously explained, any of these converters may be run either on the D.C. lighting load, or "on traction," by means

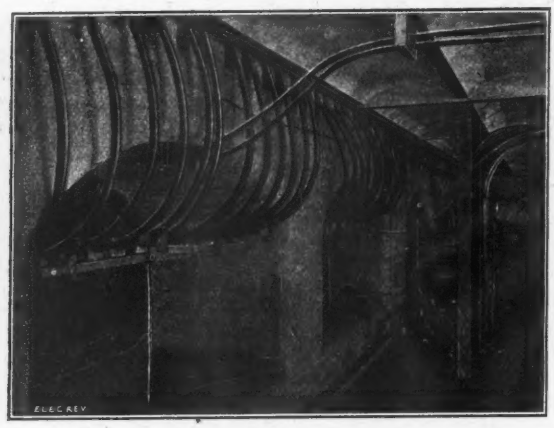


FIG. 5.—STATION CABLES ENTERING CABLE TUNNEL.

of the triple-pole main change-over switch on the generator panels.

An interesting point is the wide pressure regulation possible on the D.C. ends of these converters which varies from 460 volts for lighting (shunt wound) to 600 volts for traction. This variation is handled solely by a regulating resistance in the shunt field circuit. As previously observed, the power-factor may be leading when on traction load, and is never below ·96 on lighting.

It will appear that these converters may (or may not) be operating in parallel on both the A.C. sides and the D.C. sides—but in either case no trouble whatever arises in operating these machines in parallel, whether the D.C. ends are in parallel or not.

The starting-up of these converters is accomplished by switching the high-tension (3,000-volt) current, direct to the stator winding. On the 750-KW. converters three of the 12-phase windings of the rotor are brought out through slip-rings to a non-inductive metallic resistance, the neutral point of which is earthed, and connected to the middle wire of the D.C. lighting system (and also to the negative (rail) of the traction system). On the 1,250-KW. converters, six tappings are brought out from the rotor windings, through slip-rings, also to an external non-inductive resistance, the neutral point of which is earthed, as above. The other ends of these windings are permanently connected to the D.C. armature windings, through the shaft, which is hollow, and supported by a central bearing between the A.C. and D.C. sides of the machine.

The stator currents induce currents in the phase windings of the rotor, and the machine starts up as an ordinary induction motor. When the speed rises to synchronism—which can be observed by the oscillations of the pointer of a voltmeter connected across the starting resistance—this resistance (which is not variable as in three-phase converters) is short-circuited by a switch on the starter.

The converter is now in parallel on the A.C. side, the slip-rings and the open ends of the remaining windings being short-circuited by a lever on the end of the shaft.

During the starting-up period, the D.C. end of the converter is not connected to the D.C. bus-bars at all, the only D.C. circuit closed being that of the shunt field.

Slight variations in speed before synchronising can be made by altering the shunt field resistance—but practice has shown a more or less permanent position for the field regulator—on starting.

Mr. J. W. Saaler, A.M.I.E.E., of Messrs. Sykes & Co., Johannesburg, who obtained part of the converter contract, gives the following test figures for one of the 750-KW. converters, in a paper "On Converters," read before the South African Institute of Engineers.

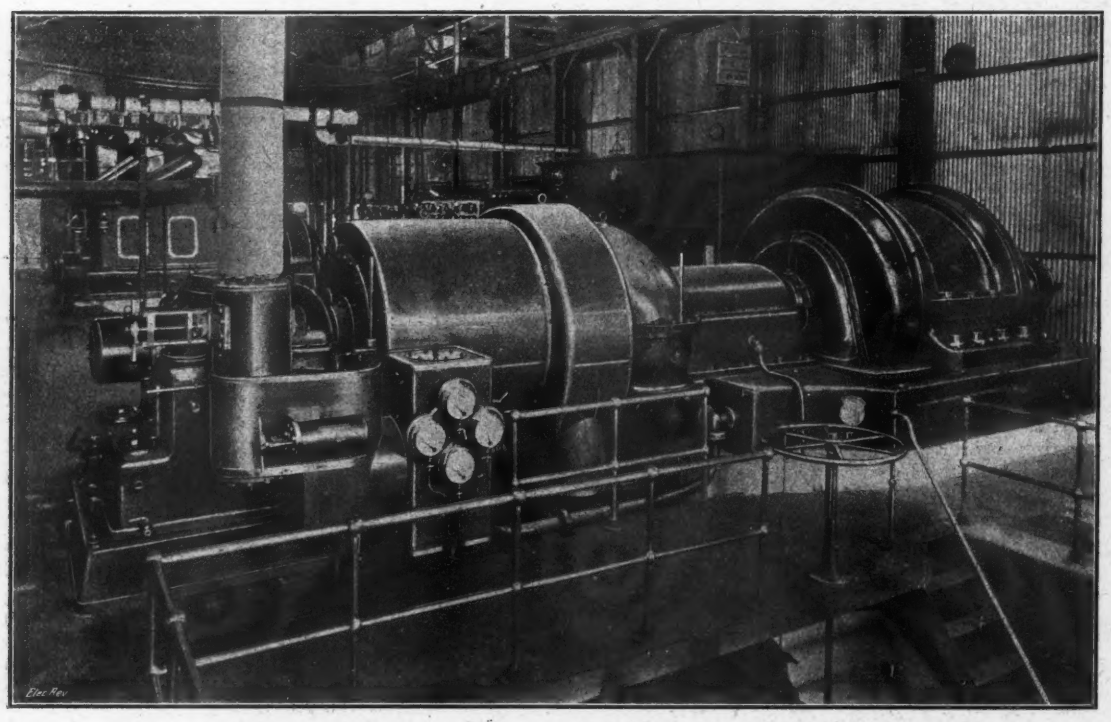


FIG. 6.—VIEW IN THE ENGINE ROOM, JOHANNESBURG MUNICIPAL POWER STATION.

MOTOR-CONVERTERS OF 750-KW. CAPACITY.

Specification.

A.C. end, 3,300 volts—2-phase, 50 periods.
D.C. end, 460/520 volts as shunt—1,630 amps.
500/600 volts as compound—1,250 amps.
Number of poles on A.C. side—8
Number of poles on D.C. side—8 } speed, 375 revs.
Number of commutating poles—8

Efficiency measured as shunt generator for lighting at 520 volts—1,445 amps., 750 KW., D.C. output.

It is assumed that the efficiency is in the neighbourhood of 91 per cent, the input, therefore, on the A.C. end is 825 KW. With this input at 3,300 volts, the current per phase is 125 amps.

	Full load.	*Half load.*
No-load losses, comprising friction in bearings and commutator, windage losses, all A.C. and D.C. iron losses, measured	29·0	29·0
Resistance of shunt winding 76·5 ohms, hot shunt current about 6·5 amps....	3·2	3·2
No-load losses	32·2	32·2
Resistance of stator winding 0·18 ohm hot per phase—		
Full-load current, 125 amps. ...	5·65	—
Half-load current, 63 amps. ...	—	1·43
Resistance of rotor winding 0·019 ohm per phase hot—		
Full-load current, 193 amps. ...	8·5	—
Half-load current, 96·5 amps. ...	—	2·12
Resistance of D.C. armature winding, 0·0067 ohm hot—		
Full load 1445/1·5 = 965 amps. ...	6·25	—
Half load 723/1·5 = 482·5 amps....	—	1·56
Resistance of interpole winding hot, 0·00037 ohm—		
Full load, 1,445 amps.	0·77	—
Half load, 723 amps.	—	0·19
Commutator current losses at 1·445 amps., drop two volts, resistance 0·00138	2·88	—
Half load, 723 amps.	—	0·72
Total losses ...	56·25	38·22

Total losses in per cent.—

Full load $\frac{56{\cdot}25 \times 100}{806{\cdot}25} = 6{\cdot}97\%$ Half load $\frac{38{\cdot}32 \times 100}{413{\cdot}22} = 9{\cdot}25\ \%$

Efficiencies—

At full load = 93·03 % At half load = 90·75 %

The cable work at the back of the D.C. main board, the roomy cable chamber (fig. 4) beneath the oil switch cubicles, and the system of supporting the machine and feeder cables, are worthy of note.

Fig. 5 shows cables from the station entering the main cable tunnel, about a quarter of a mile long.

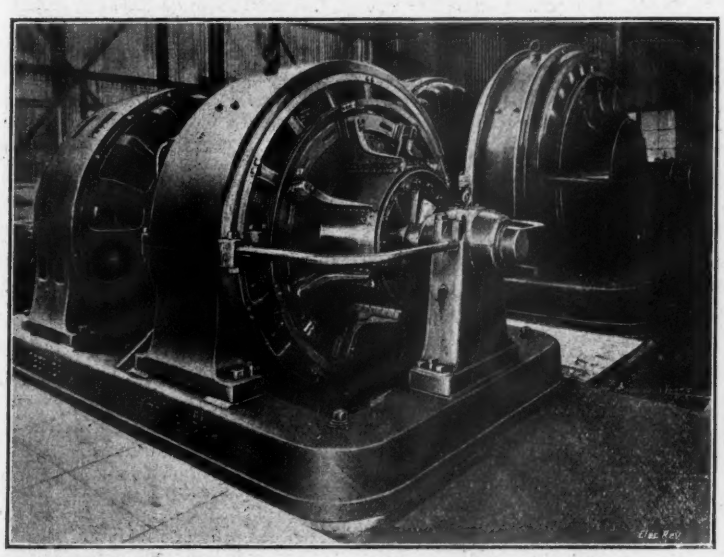


FIG. 7.—MOTOR CONVERTERS, JOHANNESBURG POWER STATION.

A comprehensive view of part of the converter plant is shown in fig. 7, the view showing one 750-KW. and one 1,250-KW. Peebles converters.

The three steam turbines at present installed were made by Messrs. Belliss & Morcom, and were supplied through Messrs. Reunert & Lenz, their Johannesburg agents. They are each of the high-pressure re-action type, but two of them are furnished with exhaust steam belts, as shown in fig 6. The turbines are not supplied at present with mixed pressure steam, that is to say, the exhaust from the reciprocating Belliss sets is not utilised in the turbines, but passes direct into separate condensers.

The reason for this is not obvious, as, on the peak loads, the Belliss reciprocators carry anything up to 2,000-KW. load, and sometimes more.

Each turbine has its own condenser, of the surface type, having a cooling surface of 7,200 sq. ft. with 3,670 tubes 10·2 in. long. Their intended duty is to condense 46,200 lb. of steam per hour, and to maintain a vacuum within 1·6 in. of the barometer, with circulating water at an initial temperature of 70° F.

The circulating and kinetic air pumps are motor-driven at the following speeds:—Air pump, 1,500 R.P.M., and circulating pump,* 600 R.P.M. Each turbine has a cooling tower to deal with its condenser circulating water, the towers being erected directly over their individual cold wells. As these wells are at different levels, the necessary by-pass pipes and valves are fitted to maintain the water levels in the wells, or dams. The circulating pumps are situated outside the station proper, and have both A.C. and D.C. drives. It will be understood that the problem of circulating water in Johannesburg has presented some difficulties, as the town is situated in an extremely dry area, and all cooling ponds are artificial. Make-up water, for circulating purposes, comes from bore-holes sunk in the immediate vicinity, or, as stand-by, from the Rand Water Board, but in the rainy season there is no need for make up.

The turbo-generators call for little comment. Each supplies current at 3,000 volts, 50 ~ two-phase; and each has a direct connected exciter on the generator shaft.

There is at present no arrangement for operating the exciters in parallel, each machine and exciter comprising a unit.

The Belliss reciprocators shown in the background of fig. 6 are of the standard triple-expansion type, each direct connected to a continuous-current generator. These four engines exhaust directly into two condensers situated between the sets, the condensers operating individually, or in multiple as may be required.

As the switchboard gallery is placed at one end of the station, two operator's signalling devices have been installed, one for the turbines and one for the reciprocators.

Each is operated from the switchboard gallery, the various signals being shown on illuminated boards, attention to which is drawn by trembling bells.

A point not without interest is the fact that no shift engineers are employed in the Johannesburg Municipal Power Station. The responsibility of operating the station is vested in a shift electrician, who is virtually, though not nominally, in charge. All switching operations are carried out by the shift electrician, who by signal advises the drivers concerned if more machines are required. The drivers and boilermen are each made responsible for their own part of the work—and although at first sight such an arrangement would seem to point to trouble arising, such has not occurred. It is well to add that the station engineer resides on the property, and is always within call.

The 1,000-KW. alternator, coupled to a Belliss reciprocator, together with the two 250-KW. Allen engines, are erected in a separate engine room, adjoining the present boiler house—which building originally housed the first belt-driven bi-polar generators, before the gas engine period. This 1,000-KW. Belliss set and the two small Allen sets are run non-condensing—but this is not a serious item, as their hours of service are strictly curtailed—unless in case of trouble or emergency.

(To be continued.)

* Circulating pump designed for 60 ft. head, including suction and discharge and allowance for pipe friction.

COST ACCOUNTING BY MACHINERY.

A remarkable machine was described in a recent issue of the *American Machinist*, which is intended to replace mental labour in analysing and combining works cost accounts. The installation, which is electrically operated throughout, has been at work since October 1st, 1915. At any moment of a working week it shows how much each man has earned up to that time, the total wages accrued in each department, and the grand total of wages in all departments. It also shows during the life of each shop order how much labour has been expended on it, how much labour each department has accumulated since the commencement of the week, and the total labour expended in all departments during the same period.

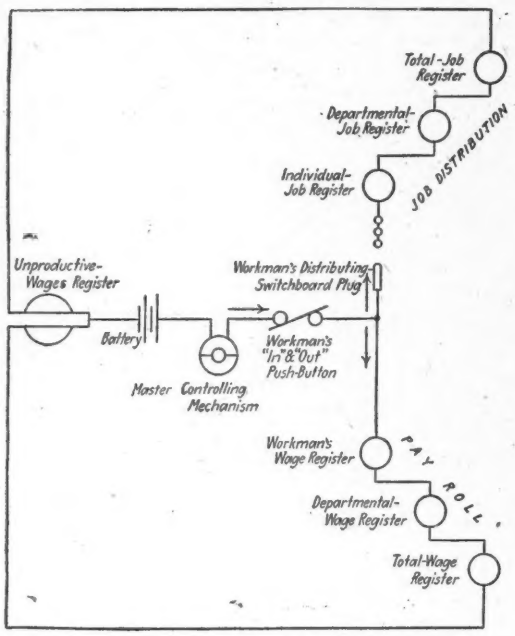


Fig. 1.—Diagram of Operation of Registers.

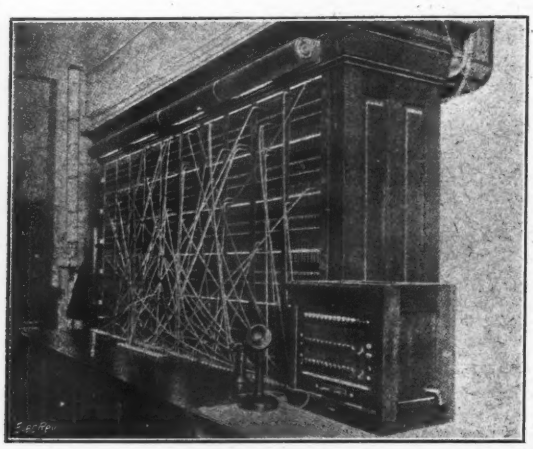


Fig. 2.—Job-Distributing Switchboard.

The machine deals with about 60 workmen; about 300 to 350 job changes are made every day, and 500 jobs can be registered at once.

The system is known as the "Chrono Cost-Accounting System," and the equipment was designed by the Synthelytic Co., of Chicago, and installed in the plant of the Liquid Carbonic Co., also of Chicago. The product of this plant is soda-water fountains, bottling machinery and soda-fountain supplies. Thus far only four departments are being served.

The equipment comprises a cabinet in which the pay-roll accounts are registered, two cabinets for job accounts, and the job-distributing switchboard. A standard type of programme clock is also provided. Only a single operator is necessary.

In a diagrammatic form the operation of the recording mechanism is shown in fig. 1. The source of electric current is a storage battery which is connected to the circuits through the master controlling machine. The recording circuit through the pay-roll registers is closed by the workman when he pushes in his button on entering the shop in the morning and at noon. On leaving at noon and night he releases his button. When the hour for beginning work arrives, the controlling mechanism begins to send electric impulses through the pay-roll registers, depending in frequency upon the man's rate. These impulses actuate the counters and accumulate his wages, a cent at a time, on one counter, his part of a departmental wage on another, and his part of the total wage of all the departments of the shop on a third.

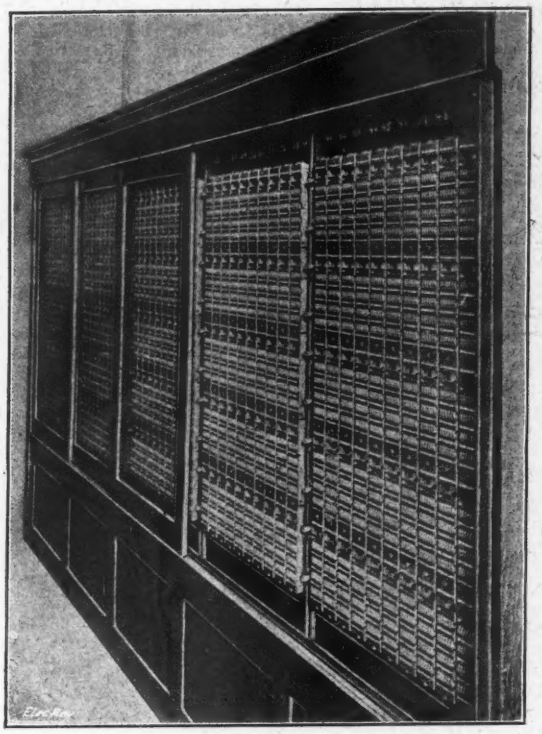


Fig. 3.—Job Labour-Distributing Registers.

These registers accumulate for each pay-roll week, which runs from Thursday morning to Wednesday evening. The totals are then transferred to written records and the counters are re-set to zero and replaced, or others already set to zero substituted for them. By these changes the equipment is made ready for the next week's pay-roll accounting.

Turning back to the diagram, it will be noticed that only the lower circuit through the pay-roll registers has been traced. There is another, and as drawn, upper, circuit passing through the job-distributing registers.

When a workman's circuit is plugged into the proper job register through the distributing switchboard, the same impulses that register his wages also register the amount of his labour, first on the individual job counter, second on his departmental job counter, and third on the job-labour counter for all the departments. The record of the individual job register is copied off as soon as the job is finished, the counter is removed, set back to zero, and

replaced ready to record another job. The department distribution totals and the grand total are used to check the pay-roll totals, and are erased at the end of each pay-roll week.

This explanation covers all the features of the diagram, fig. 1, except the "unproductive-wage register." Its purpose is to accumulate all the wages by departments that are being recorded on the pay-roll registers, but not on job-distribution registers. It is evident that for any week the sum of the readings of the "total-job register" and "unproductive-wage register" must equal the reading of the "total-wage register."

The workman's push-buttons are in the form of simple push-button switches built up into panels placed near the shop entrance. White buttons register in, and black ones, out. These panels replace the usual time clocks.

The payroll register cabinet has been developed from a measured-service meter that has been used for years in telephone exchanges. The job-distributing switchboard, which also has been adapted from telephone practice, is shown in fig. 2. The plugs when inserted into the jacks connect the source of electric impulses for individual jobs with the job-distributing counters for the jobs on which they are

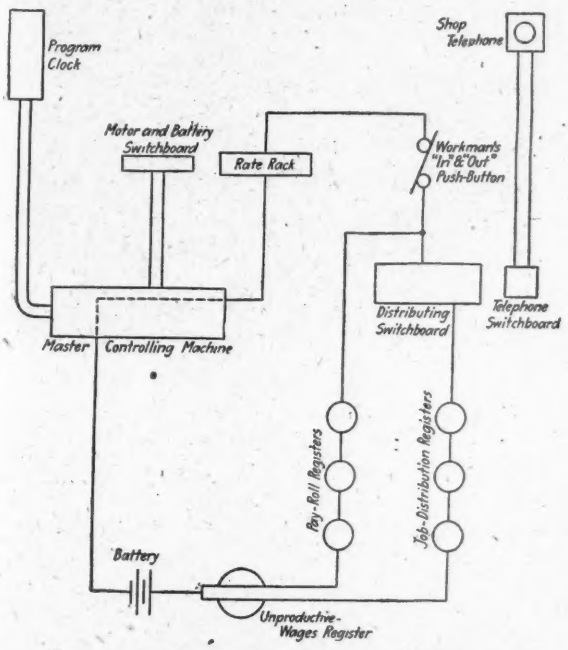


FIG. 4.—ARRANGEMENT OF COMPLETE EQUIPMENT.

working. The counters are shown in fig. 3; five counters are fitted in a frame and form a unit. Each counter records from 1 cent up to $9999.99 by one-cent increments, and each electric impulse accumulates one cent. On the back of each registering unit is a locking device which prevents any movement of the counter wheels when a strip is removed from the cabinet.

The devices that control and send the electric impulses which actuate the registers consist of a master controlling machine, a programme clock that controls its operation with reference to elapsed time, a switchboard and rheostats that control the driving motors of the machine, a storage battery supplying current for the registering circuits, a rate rack for the workmen's rates of pay, and a private telephone system to convey information with regard to jobs. The machine can be run at normal speed, 1½ times or twice normal. The whole arrangement is diagrammatically shown in fig. 4.

The principle on which the system operates is that of figuratively allotting to each workman a small fraction of his wages at short intervals, the amount being always one cent, and the interval being varied according to the workman's rate of pay. An impulse is "offered" to every circuit once every minute; whether it is sent on or not depends on the circuit being open or closed, and this is determined by the relationship of the man's rate and any particular minute in question.

The rates are set as regards the mechanism by the rate rack, which provides groups of connections for all even-cent rates from 6 to 60 per hour. The circuit from each man's push-button is through the rack and the particular group of connections corresponding with his rate. An impulse from the machine for a 30c. man finds a closed electric circuit only every other minute.

The information for the completion of the circuit between an individual man's rate-rack connection and the proper job register is received at the distributing switchboard over the private telephone system. When a workman begins or finishes a job he telephones his own number and the job number to the switchboard. From this information the switchboard operator makes or breaks the proper connection. It is evident that this distributing board is constantly undergoing changes in settings as some jobs are completed and others begun.

The master controlling machine is most ingenious in design and interesting in construction. It is driven by a three-phase motor, together with an emergency D.C. motor that will automatically pick up the load of the machine if the alternating current fails.

When the shop goes on time-and-a-half (5 p.m. to 11 p.m.), the controlling machine runs at 1½ times normal speed, and for double time (11 p.m. till morning) at double speed. Provision is made to meet the case of labourers who are paid at lower overtime rates, and for odd fractional rates of payment.

Supervision is arranged for at two places—on the distributing switchboard and in a special lamp panel in the superintendent's office. Under normal working conditions a lamp glows on the superintendent's panel for every man whose wages are being added to the unproductive-wage account. By pressing a button a lamp glows for every man who is registered as in attendance and is drawing wages. Similar signals show on the plug shelf of the switchboard.

Beyond this, each man's circuit is provided with a lamp located near the switchboard plugs. These light at the instant that an impulse is being sent along their associated circuits to the registering mechanism. The purpose behind this feature is to forestall the possibility of plugging a man from one job to another at the precise instant an impulse is being sent over his circuit.

ELECTRIC RAILWAYS.

THE "James Forrest" lecture, which was prepared for the Institution of Civil Engineers by Mr. H. M. Hobart, M.Inst.C.E., and delivered on his behalf by Mr. J. A. F. Aspinall, is a compendium of information on the subject of electric railways in general, and especially upon recent progress in the United States. So rapid has been the development in this branch of engineering since electric locomotives commenced running on the City and South London Railway in 1890, that there are now 3,460 miles of steam railway track converted to electrical operation in the United States and Canada alone; on the other hand, there remains 380,000 miles of track still operated by steam, so that there is abundant scope for future conversion. The author gives the total mileage of electric railways in the United States and Canada as 45,000 miles, but this clearly includes tramways.

During the last five years the mileage of steam railway converted has more than doubled. The reason given for this rapid growth is the continual

decrease in the cost of electrical energy, which in turn has been accelerated by the railway demand: even ten years ago a price of 1d. per KW.-hour would have been the minimum permitting of any profit, whereas now electrical energy can be purchased at little more than ½d. per KW.-hour, and on the Butte, Anaconda and Pacific Railway the cost is 0.265d., whilst the Chicago, Milwaukee and St. Paul Railway will pay only 0.26d.; in both these cases the electricity is derived from water-power. The cost of plant has also come down with a run; a 3,000-KW. set 15 years ago cost £30,000, whereas now a 30,000-KW. steam-turbine-driven set can be obtained for less than £60,000, and consumes only ⅔ as much steam per KW.-hour.

While the fixed charges are lower than the operating costs in the case of a steam-driven station, the reverse holds good for the hydro-electric station, and for load factors above 20 per cent. the total costs of the latter are much the lower, so that, as an electrically-operated railway has a fairly good load factor, the greatest progress has been made with railway electrification in countries possessing abundant water-power. The author sets out the working costs of a 150,000-KW. steam-driven generating station equipped with generating sets of 30,000-KW. each, with a load factor of 50 per cent., and shows that with fuel at 8s. per ton, the total costs amount to 0.265d. per unit, of which fuel accounts for 0.075d. Transmission for a distance of 100 miles adds only 0.08d. per unit to the cost. Whilst an electric locomotive may have a load factor of only 15 per cent., the combined load factor of 30 locomotives may be as high as 60 per cent., thanks to the diversity factor of the system, which in this example is 4.0. But by combining the loads of other consumers with the railway load, a still better load factor can be obtained, and hence a railway rarely generates its own electricity at so low a cost as that at which it can be manufactured by a company giving a general supply.

These principles have been put into practice recently on a scale so large as conclusively to demonstrate their correctness; as an example, the author describes the B.A.P. Railway above-mentioned, a mountain-grade system employing a considerable number of freight locomotives; this system was described in our issues of March 27th and April 3rd, 1914. It comprises 114 miles of single track, and was formerly operated with 27 steam locomotives, consuming 197 lb. coal per locomotive-mile, which coal cost 19s. per ton. The electrification of the system has been nearly completed, and at present the traffic is handled with 17 electric locomotives and four steam locomotives; the former consume 26.3 KW.-hours per locomotive-mile, at 0.265d. per unit, costing 7d. per mile, as compared with 19.9d. per steam locomotive-mile for fuel. The line voltage is 2,400 volts D.C., the motors being wound for 1,200 volts and permanently connected two in series. The electric locomotives have a maximum tractive effort of 48,000 lb., and a continuous tractive effort of 25,000 lb. at 16.2 M.P.H. corresponding to 1,080 H.P. The net ton-mileage at present carried by the railway is some 170 million ton-miles, the gross ton-mileage, including the locomotives, being 400 million ton-miles per annum. With electric traction the average weight of the ore trains has been increased from 1,600 to about 2,100 tons; two locomotives can haul a train weighing in all 4,300 tons up a grade of 0.3 per cent. at a speed of 16 miles per hour, which is more than twice as fast as the lighter trains (3,600 tons) hauled by the steam locomotives.

The author analyses the performance of the electric locomotives at some length, and shows that the efficiency of the locomotives from pantograph to drawbar is of the order of 80 per cent.; he also compares their performance with that of the steam trains, and finds that the outlay for fuel and power has decreased by 39 per cent, with electrical operation. Owing to the greater speed and the heavier trains hauled by the electric locomotives, the number of trains per day has been reduced by 25 per cent., resulting in a saving of 33 per cent. in the total hours of work of engine crews as well as a reduction of 21 per cent. in trainmen's wages. In the passenger service on the same railway, the delays to trains amounted to only one-fourth as much as with steam haulage. The total net annual saving due to the adoption of electric haulage amounts to £74,000, whilst the capital outlay on the electrification is estimated at £300,000, and the author considers it safe to say that by the year 1920, seven years from the commencement of the conversion, the savings effected by electrical operation will have wiped out the entire cost of the work.

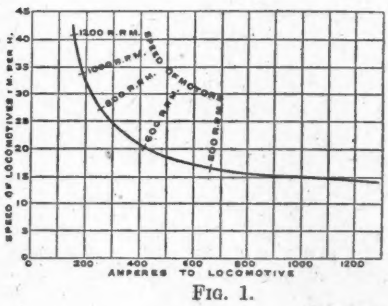


FIG. 1.

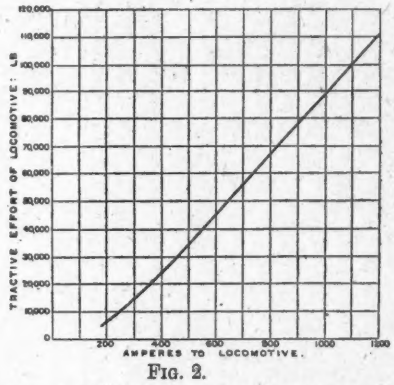


FIG. 2.

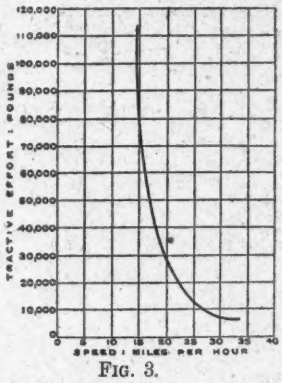


FIG. 3.

CHARACTERISTICS OF 3,000-H.P. ELECTRIC LOCOMOTIVES.

Mr. Hobart states that the chief item of expense in electrifying a railway of this character is that for electric locomotives; these are comparatively new types of machine, and cost (gear-driven) from £80 to £90 per ton, whereas steam locomotives are thoroughly standardised, and cost only £30 per ton. Against this must be set the greater weight of the steam locomotives (2:1), and the greater traffic-handling capacity of the electric locomotive, and the author find that 21 electric locomotives costing £134,000 would be equivalent to 32 steam locomotives, which also would cost £134,000. As the design becomes standardised, the cost of the electric locomotive is certain to decrease.

Electric locomotives cost far less than steam for repairs, this item on the B.A.P. Railway amounting to 2.2d. per locomotive-mile for the former compared with 6.5d. for the latter.

The employment of the 2,400-volt system enabled the two sub-stations on this line to be spaced 26 miles apart; had the pressure been 600 volts, at least six sub-stations would have been necessary, costing more than twice as much and having a lower load factor and lower efficiency, whilst the wages of at-

tendants would have been correspondingly greater. Motor-generators are employed, running at 720 R.P.M., and rated at 1,000 KW. (1,500 KW. for 2 hours). Each synchronous motor drives two 1,200-volt generators connected in series; the latter are compound wound, provided with interpoles, and fitted with distributed compensating windings in the pole shoes. The average sub-station load factor is about 34 per cent., and the average load 2,050 KW. The motors are run with over-excited fields so as to have a leading power-factor, which offsets the lagging power-factor of other customers of the Great Falls Power Co., which supplies the energy to the railway company.

The trolley conductor has a cross-section of 0.166 sq. in., and the cost of the distribution system has amounted to £1,110 per mile of single track, of which one-half represents the cost of erection. The current collected by two locomotives attains a maximum of about 800 amperes, and as it may not divide equally between the two pantograph collectors, a single contact may carry as much as 500 amperes; the trolley wire can carry 1,000 amperes continuously with a rise of temperature of 180° C. in the open air, and as the current comes from both directions along it, the system can deal with four 72-ton locomotives between two adjacent feeding points, requiring an aggregate of some 2,000 amperes. Under normal conditions of running the average current collected per pantograph is only 400 to 500 amperes when starting and ascending grades.

Mr. Hobart next deals with the still more important Chicago, Milwaukee and St. Paul Railway, which is being electrified at 3,000 volts D.C. for a length of 440 miles, comprising 650 miles of single track; eventually it is expected that the electrification will be continued to the Pacific coast, making a total route length of 850 miles. The system was described in our issue of November 5th, 1915. Forty-two electric locomotives, each weighing 250 tons, with equipment for 14 sub-stations, are being supplied, and a length of about 113 miles has just recently been put in electrical operation; energy is purchased from the Montana Power Co., which has 10 hydro-electric plants in this region, having an ultimate aggregate capacity of over 200,000 KW. The electricity will be supplied at a pressure of 100,000 volts, 60 cycles, at 0.26d. per unit. With 3,000 volts on the line, the sub-stations are spaced at an average distance of 32.5 miles apart, but the actual distance varies from 18 to 43 miles. Gradients of 2 per cent., 21 miles long, and 1.66 per cent., 10 miles long, have to be overcome.

The sub-station machinery is similar to that of the B.A.P. Railway, but the sets are of 1,500 and 2,000 KW. continuous rating; the total capacity installed is 59,500 KW.

Each locomotive has a continuous rating of 3,020 H.P., and is thus 40 per cent. more powerful than two B.A.P. locomotives; a noteworthy feature of the former is the equipment for regenerative braking for long periods on down grades. The collector has a double contact device, and can collect 2,000 amperes from a double trolley wire at 60 M.P.H. The line is equipped with the double-wire catenary construction, having two No. 0000 wires both suspended from the same catenary wire, but by independent hangers, the suspenders of one wire being midway between those of the other. The two wires hang close together, and the alternate suspension provides exceedingly smooth operation, with complete elimination of any tendency to flash at the points of suspension. The tractive effort of the locomotive at 15.9 M.P.H. is 71,000 lb. (continuous rating), and is provided by eight motors, each driving one axle; the locomotive can haul a load of 2,250 tons, in addition to its own weight, up a gradient of 1.0 per cent. at 15.9 M.P.H., developing 3,020 H.P., with a pantograph-drawbar efficiency of 80 per cent. As in the case of the B.A.P. Railway, the motors are cooled by the forced circulation of air from an external blower. The accompanying figures, 1-3, show the characteristics of these locomotives.

The heaviest duty imposed upon the locomotives is drawing a load of 2,230 tons 49 miles up an average gradient of 0.7 per cent., the ruling gradient being 1 per cent.; the speed is 16.5 M.P.H., and the average output of the motors 2,380 H.P. The cost of electrical energy is 43d. per train-mile, compared with 58d. for steam.

Allowing for fuel and power, wages, repairs, and capital charges, the annual outlay per electric locomotive-mile is given as 43.3d., as against 47.5d. for steam traction; but this figure takes no account of the indirect economies recorded due to the heavier trains and higher speeds, which increase the capacity of the railway and reduce wages. Moreover, the C.M. & S.P. Railway locomotives are equipped with regenerative braking, which is estimated to effect an economy of about 25 per cent.; wear on wheels and brake shoes will be decreased, and the speed on down grades may be higher in the absence of heating of

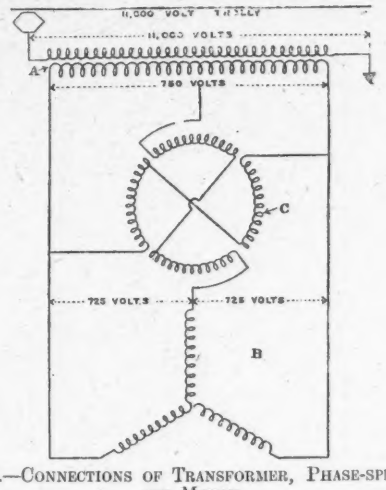


FIG. 4.—CONNECTIONS OF TRANSFORMER, PHASE-SPLITTER, AND MOTOR.

tires. Another advantage of regenerative braking is the fact that the energy thus generated by descending trains is supplied to neighbouring ascending trains, with a greatly reduced loss in transmission, and the capacity of the generating and sub-station plant is virtually increased. The author points out that, though regenerative operation was considered 10 or 15 years ago, it would not then have had the advantages which now accrue, owing to the greater weight of the electrical equipment in those days and the increase in the total weight of the train due to the regenerative feature. In the case of an electric railway handling dense traffic, requiring, say, 100 million KW.-hours per annum, by the adoption of regenerative control the plant necessary might be reduced from 25,000 KW. to 22,500 KW., and this would run through the whole of the system.

Mr. Hobart next deals with the Norfolk and Western 11,000-volt single-phase railway, comprising 29 miles of double track (97 miles of single track). Electrical operation was commenced in May last year with 12 240-ton locomotives, each consisting of two 120-ton units. Trains weighing 2,900 tons, in addition to two 240-ton locomotives, are hauled up gradients averaging 1.13 per cent. and 15 miles long at 14 M.P.H., twice the speed at which three 240-ton steam locomotives took up similar trains. The advantages claimed for this electrification are similar to those already set forth; in this case also regenerative control is employed, and by relieving the congestion at a single-track tunnel 4,000 ft. long, the carrying capacity of the line has been greatly increased. Fig. 4 shows the connections on the locomotive; electricity at 11,000 volts, 25 cycles, is received by a step-down transformer carried on the locomotive, and indicated at A, fig. 4. The pressure

at the secondary terminals of this transformer is 750 volts. Part of the electricity goes direct from the secondary of the transformer to the polyphase motors (indicated diagrammatically as B in fig. 4) which drive the locomotive; the remainder of the electricity passes through the phase-splitter C on its way to the polyphase motors B. By this means the single-phase electricity supplied to the locomotive is converted into polyphase electricity, and is thus made suitable for driving the polyphase motors. Each 240-ton locomotive is equipped with eight of these motors.

With a view to economical working, the tendency on American railways for many years has been to keep down the train-mileage and to increase the ton-mileage, involving a continual increase in the power of the locomotives; in 12 years the average tractive power was increased 50 per cent., and the capacity of freight cars 40 per cent. Not only can this policy be most effectively carried on with electric locomotives, but the latter also enable the speed to be doubled.

The author proceeds to describe the "1913" type of electric locomotive in use on the New York Central Railway, which weighs 115 tons and has a continuous rating of 2,000 H.P., with a tractive effort of 13,840 lb. at 54.5 M.P.H., on a 600-volt D.C. third-rail system. The armatures of the motors, which are bipolar and of 250 H.P., are mounted directly on the axles. These locomotives haul at 60 M.P.H. trains having a total weight of 1,100 tons, and have an efficiency from collecting shoe to drawbar of nearly 80 per cent.

In 1915 the total single-track mileage of electric railways in the United States operated on the single-phase system was 1,490 miles, while that using high-pressure direct current was 3,720 miles; while the adoption of the single-phase system has by no means come to a standstill, the author holds that the superiority of the high-pressure D.C. system ensures its general use on main-line railways in preference to the single-phase system, and points out that nearly nine years ago he foretold this outcome. He draws attention to the defects of the rectified single-phase current which has been adopted on some lines, and to the necessity of installing frequency-changers to obtain 25-cycle single-phase current from 60-cycle supply, thus doing away with the advantages of static sub-stations, while the efficiency of the system is inherently lower than that of the D.C. system.

The cost of supply, analysed at considerable length, is found to be about the same at the locomotive, no matter whether the high-pressure D.C. system or the single-phase 25-cycle system be employed, while a 60-cycle supply converted to 25-cycle single-phase costs rather more; but the cost of the single-phase locomotives is inherently greater than that of the D.C. machine.

Mr. Hobart concludes that the extensive conversion of steam railways is in prospect in the near future; that the D.C. system is the most appropriate; and that high-pressure D.C. locomotives are an established success.

COMMERCIAL MOBILISATION.

ON Thursday last week, at the Connaught Rooms, the BRITISH ELECTRICAL AND ALLIED MANUFACTURERS' ASSOCIATION held the fourth of its series of trade conferences, this one being devoted to the consideration of the steps that ought to be taken towards organising industry in readiness for the commercial campaign that will follow the war. The audience numbered about 120, and included many prominent representatives of industry, shipping, and finance. Mr. F. R. DAVENPORT, chairman of the Council, presided.

The discussion was opened by Mr. HENRY THORNTON, general manager of the Great Eastern Railway, with a short address which was accorded a very hearty reception. Mr. Thornton regarded it as a sign of very healthy optimism that England was discussing what was to be done with Germany when Germany was "down and out"; he shared the conviction that we would shortly make rapid progress on land and sea, and commended British manufacturers for looking ahead.

The new conditions would be strange and uncertain, and there would be tremendous changes; but England's trade would continue to progress; no doubt there would be some difficulty in finding capital, but the British Empire, which had never yet defaulted, possessed unassailable credit, an immense mercantile marine, vast Colonies with unlimited natural resources, and a population skilled in manufacturing and of indomitable pluck—with such assets at command, the Empire could never be insolvent.

The time for talking was over—the time was now ripe for *action*. The problem was how to set about the capture of foreign markets. In the United States it was recognised that very large resources were necessary for such a purpose, and that the capital could only be obtained by arousing the interest and co-operation of the entire nation; thorough organisation, machinery for the investigation of foreign markets, competent men at the head, were indispensable requirements. Accordingly, a Corporation had been formed, with a capital of ten millions sterling, for the purpose of engaging in any kind of business, and was controlled by representatives of big companies in every branch of commercial activity. But the conditions in this country were different, and he did not recommend the adoption of the American plan. At present the British had no one scheme backed by powerful influence and sufficiently comprehensive to contemplate a successful attack on foreign markets; there was, in fact, a danger that the movement might dissipate itself in a number of small and separate efforts. Amongst the essential factors of success were the assistance of the banks, the aid of linguists, the combined support of the various transport agencies, the help of the Government in every possible way, and the assistance of the Press. The Government backing in particular must be effective. As the first tangible, constructive step towards the goal, he advocated the formation of a committee of experienced business men, on which all interests should be represented, with a specially competent man at the head—a Lord Derby for commercial affairs. Let them enlist the banking interests, and send agents into the foreign markets with the weight of the whole country behind them.

Mr. C. H. MERZ emphasised the importance of making a beginning on the right lines. An organisation such as Mr. Thornton had outlined might be taken to be partly in existence already. After the war, electrical manufacturers would have to go still further on the lines this association was formed to promote. Hitherto the efforts of British manufacturers had suffered from want of cohesion and organisation; when one required plant, etc., it was embarrassing to find that so many people all wanted to quote for the same thing. This country did not take kindly to anything in the nature of a "trust," but the Association would strengthen its position if it could agree that a certain number of manufacturers should manufacture certain articles—why should so many want to make everything? Economical production with small output was not possible, and competition had gone beyond the point up to which it was of advantage to the purchaser.

The first essential to success in establishing a given export trade was prosperity in that industry at home, which would secure to it financial support, as in the case of the textile industry. The electrical industry had suffered from the socialistic experiments of Parliament, with the result that financial aid was not attracted, experience was not gained, men were not trained. The Association should insist on being given the opportunity of acquiring experience at home; there was plenty of scope for it, in connection with our big industries. Unless they could train the men at home, they could not successfully carry on trade abroad; the men sent overseas must know their work, and the goods must be of the right quality.

Mr. H. GORDON SELFRIDGE said that after this war the business men of this country would have to take up the struggle, and should prepare for the task with the help of the best intelligence available to them. England had grown so rich that the commercial fight was hardly so attractive as in olden times, but there was plenty of sport in commercial warfare; there was also a duty laid upon the shoulders of the business men, who were the wage earners of the nation, and on their efforts would depend the rejuvenation of the national finances. This country was well able to stand the strain; it should now again seize and hold the position of the world's chief manufacturing, money-making, and producing country. The Government was made up of lawyers, who occupied too big a place in most governments, and it was useless to expect support from it—they must rely upon themselves; the business men should form their own committee and carry on without reference to the lawyers. Inertia must be over-ruled—those who were aggressive must ignore those who were sluggish, and press on as in the days following the Napoleonic wars, when Britain covered the world's requirements. All depended upon the spirit, enthusiasm, and imagination of the business men; never was there such a wonderful opportunity for a nation to make itself supreme, and to make the commerce of this country a most interesting career. Londoners could hardly realise what the name of London meant to the rest of the world; the prestige and respect attached to it made it a world asset. This was the first body he had heard of which had sought to form a great combination that would set the pace for the rest of the nation; he approved of the idea of forming a vigorous committee, and declared that with the united efforts

of enthusiastic business men this country could do anything it chose.

Mr. COLTON declared that they must fight the Germans to a standstill; the enemy had developed a great commercial machine, with the aid of money obtained from British banks—what would they do for capital in the future? Already they were considering means for strengthening their strong organisation and overcoming the prejudice which had been created against their wares.

Mr. S. Z. DE FERRANTI expressed the pleasure he felt at seeing the B.E.A.M.A. acting on the right lines to bring about success. The first thing to be done to promote trade after the war was to make sure of our own home market. It would be better for the country if British manufacturers consisted of a moderate number of very rich and prosperous concerns instead of many small and poor ones. The electrical industry had suffered under conditions of the most severe competition and legislative restrictions in the past; adversity brought out one's good qualities, but might be carried too far. In order to go ahead and secure command of the world's trade we must have plenty of money for development work. From a technical point of view, to arrive at the most perfect product required a steady flow of money and continuous progress; the development of the world's markets also required that plenty of money should be available. For these two reasons prosperity in the home markets was essential. After the war they must not work under excessive handicaps, they must be strong and have ample funds at command. America and Germany protected their home markets, and upon success at home Germany built up her foreign successes. Municipal enthusiasts here used electricity as their plaything for socialistic experiments, and the politicians killed what otherwise might have been another textile industry in point of national importance. The textile industry grew to huge proportions unhindered, whereas Parliament cramped the electrical industry, as it had also strangled the automobile industry. The greater the prosperity in any industry, the better for all the people. He fully endorsed what other speakers had said about the after-war campaign; they must use every precaution to conserve their energies. He himself held extreme views; they were dealing with an enemy that was as unscrupulous and dirty in commerce as on the field of battle, and as vermin was exterminated without compunction, so we should use every available method of crushing the enemy. He would like to see the allied nations utterly exclude everything Teutonic—forbid German ownership of property, refuse to hold intercourse with them, shut out their goods entirely. They must give no heed to objectors; the devil was always there, and would break out again if the chance were given. No half-measures—let them bar out the Germans from any chance of commercial recovery, by completely closing the Allies' markets to them; the enemy would never overcome this handicap and again become a great commercial power. But if such proposals were too extreme, at any rate let them do all that they could to protect home markets, and combine to fight for the world's markets.

Mr. F. W. WILE, referring to Mr. Runciman's recent speech, said that that gentleman planted a most insidious idea in the minds of the British public when he said that Germany was already commercially a defeated nation, lulling the people into a false sense of security. He could hardly pick up a German paper that did not show that Mr. Runciman was utterly mistaken. In Germany the co-operation of the Government with big businesses was a great success; the German Government promoted trade by means of its diplomatic and consular services. The German State-owned railways and canals and the great shipping lines co-operated, and three departments of the Government, with business men at their heads, were devoted to the same purpose. Germany was now throbbing with movements and efforts directed towards the resumption of trade after the war, and was by no means commercially beaten. With 1¼ million square miles of territory and a population of 200 millions at her command, Germany was nowhere near famine, and could never be beaten by starvation—she would have to be knocked out on the field of battle.

Winding up the discussion, Mr. DAVENPORT said that most of them agreed with Mr. Wile that there was too much optimism. A concrete organisation should be created, with representatives of all the principal engineering associations, for the single purpose of improving British industry; it was the duty of the leaders to keep the British engineering industry in as powerful a position as possible. With regard to trusts, they had no desire to become a trust concern; they wished to adopt a reasonable and moderate policy, and the general desire to play the game would prevent the nauseous trust atmosphere from arising. The Association was ready to join with the central organisation in helping all British industries, and would do its share to bring about co-ordination and cohesion of the interests involved.

Mr. JAMES KEITH was unable to speak at the meeting, but communicated his views to the secretary. He wished to point out that Mr. Runciman had been rather unfairly criticised, whereas, for one thing, he had promised a new Patent Act, a matter of the first importance. Mr. Keith advocated the establishment of a real search for novelty and validity before an application for a patent was even entertained, the abolition of renewal fees, extension of the period of the patent to 17 years, Government protection for the *bona-fide* inventor, a special Court solely for trying patent cases, etc., and urged that in the formulation of a new Act, inventors, engineers, and business men of the first rank should be taken into consultation. The revolutionary Act of 1883 was framed and carried by a business man—the late Mr. Joseph Chamberlain—whereas the 1907 Act was drawn up by a lawyer, and, hence, had practically failed to give anything like satisfaction or justice to British inventors. He called for the exclusion of German and Austrian trade from our business relations for ever. The appointment of a Minister of Industry and the improvement of the patent law would bring this country into line with the United States, which would undoubtedly be our future principal competitor for the world's trade, and Britain would then have every chance of holding its own in the coming struggle.

CORRESPONDENCE.

Letters received by us after 5 P.M. ON TUESDAY cannot appear until the following week. Correspondents should forward their communications at the earliest possible moment. No letter can be published unless we have the writer's name and address in our possession.

Electric Iron Connections.

May I draw the attention of the manufacturers of electric flat-irons to the numerous inquiries I have received for an electric flat-iron that will not require its socket connection rewired, after a few months' use? Almost everyone in the electrical profession must know of this trouble, which, I should say, is caused by the electric flat-iron, when connected to the supply, and not placed with its face on a heat-conducting substance, reaching a very high temperature. The heat is conducted to the terminals and socket connection, passing along to the flexible cord. The conductor itself becomes hot, the insulation is slightly charred, and very quickly the conductor breaks. I have carefully examined the broken ends of the conductor and noted the dryness of the insulation, especially between the break and the socket connector. Could not this trouble be obviated by introducing a perforated socket connector that would allow a cool draught of air to pass through it? Surely this improvement would bring the electric flat-iron to a higher state of perfection.

E. A. Deacon, *Student I.E.E.*

Twickenham, *January 19th*, 1916.

The Institution of Electrical Engineers and Alien Enemy Members.

The correspondence upon the above question and your references thereto have attracted considerable attention, and we have been much interested in the subject.

With your kind consent we now propose to state our views upon the alien enemy question in general, and its application to alien enemy members of the Institution. We wish to state at the outset that we think the alien enemy (whether naturalised or not) should, for the reasons set forth below, be excluded from any kind of association with true Britishers. The alien enemy has conclusively placed himself quite outside all claims to civilisation and consideration:—

1. By the ghastly atrocities committed in Belgium, France, Serbia, and other countries upon helpless and innocent non-combatant inhabitants (Lord Bryce's report deals pretty fully with these matters, but the cases dealt with in the report are the least horrible, many others, of which full records are kept, being quite unfit for publication, and representing horrors unspeakable).

2. By the deliberate and wanton murder of civilian passengers on board the *Lusitania* and many other liners and ships.

3. By air raids upon civilians in London and numerous other cities and towns, to say nothing of the destruction of valuable property.

4. By the use of dastardly methods of warfare, such as gas, liquid fire, explosive bullets and the like, before unheard-of in the annals of civilised warfare, and in direct contravention of its rules.

5. By the murder of Nurse Cavell.

6. By the diabolical treatment of Allied soldiers who have been taken prisoners by the enemy, but more especially those who are British.

These crimes against humanity have been committed, not only by common soldiers, but in innumerable instances by officers and professional men, who, in many cases, have been taken red-handed at their foul and devilish work, or whose acts have been described on oath by reliable witnesses. In other cases they have been committed by the direct command of high officers or by their knowledge and consent. So much for the very brief résumé of the acts and nature of these high priests of "Kultur."

The above proves that the alien enemy is either a degenerate of the vilest type, and his once much-lauded and advertised civilisation only the thinnest veneer, which was both put on and stripped off at will to serve his own unworthy ends, or he has always been at heart of the most brutal and degraded nature, and has succeeded in concealing the fact as long as it suited his plans.

In any case, he has effected his purpose in worming his way by treachery and deceit into the confidence of the world at large, and now laughs at the fools who accepted him at his own valuation and made a friend of him. In August, 1914, he began to reveal his true nature, and has continued to do so more and more plainly every day up to the present time.

It has been urged that to class the naturalised alien with all the others of his race generally would be an injustice. Suppose such may be the case with a few individuals; is it not better that a few may suffer some sort of injustice than that the many should escape punishment? How many thousands of innocent men, women and children have suffered the vilest torture and death at the hands of the bestial and brutal enemy? yet an outcry is raised because it is proposed to give a few naturalised alien enemies the cold shoulder. Cases have been cited of alien enemies who have been naturalised in England for a number of years and who have relatives fighting for us. We have frequently heard that the love of the alien enemy for his country amounts almost to a religion, and that patriotism is far stronger amongst them than amongst Englishmen. If that be so, and we have no reason to doubt it, the reasons for distrusting the naturalised alien are increased.

When the hypothetical alien (now naturalised for many years) first came to this country, he came not for his country's good, but obviously in his own interests. His attachment (if he has any) is, therefore, a purely selfish one, and if he is in accord with his sons or other relatives fighting against his Fatherland, he is obviously a traitor to his own country, and cannot, therefore, be trusted to be loyal to any.

Suppose the enemy succeeded in landing in England, and even reached London: which side do you suppose the naturalised alien would take, bearing in mind the record of his race? After all, his naturalisation is represented but by a scrap of paper, and as a leopard cannot change his spots, so the alien is an alien still, and can become de-naturalised as easily as he was naturalised, and, indeed, very much more easily, for all he has to do is to put the papers in the fire and he becomes a true and faithful member of the Fatherland again. No, sir, if a tiger lives in a stable, or is even born in a stable, he does not become a horse, but remains a tiger for the rest of his life, and, although he may be apparently tamed, his true nature will be revealed under provocation.

War with our present enemies (at one time our dear and *trusted* friends) has been forecast for years, and those who ought to know have said that it was not intended to embroil England at present, but when France and Russia had been laid low, and the enemy had had time to recuperate (say, in ten years or so), then England's turn would come.

In this connection it is instructive to note that Dr. Klingenberg delivered a few years ago at the Institution an address on how to supply light and power to London, and advocated one or two huge generating stations for the purpose, the present generating stations to be turned into sub-stations and distributing centres; in other words, putting all our eggs into one basket (or two at the outside). A scheme was ultimately proposed, more or less upon these lines, and was urged by the promoters as the ideal thing, whereby everybody was to get a supply for next to nothing.

Now, suppose this scheme had gone through, it would probably have been completed just in time to suit the enemy. An air raid or two, and what condition would London be in? Two well-aimed bombs upon two splendid targets, and London would be in a state of chaos. One more upon the gas works and the work would be complete: all lights out and munition works shut down. "Far-fetched," some may say; but is it? We know only too well, by bitter experience, the craft and foresight of the enemy. Ask America and practically every other civilised State in the world who are hag-ridden by the enemy, and can scarcely call their souls their own, what they think of it.

The danger to England is a very real one, for she has never before had to fight an enemy who does not possess a scrap of honour, or even common honesty, and as she cannot use similar weapons and means used by the enemy, she and her allies are at a great disadvantage, and have been from the beginning. If we had had an honourable foe to deal with the war would doubtless have been over long ago.

One fact is plain to all but those who wilfully, and perhaps intentionally, close their eyes, and that is that Germany must go under, or England will do so sooner or later. How anyone can have the slightest confidence in any member of a race possessing a philosophy and morality (or, rather, lack of morality) such as they possess, to say nothing of their blasphemous hypocrisy, is a mystery to all who are not biased in their favour, rather than in favour of their own flesh and blood and the land of their birth.

We have been told that many naturalised alien enemies have expressed their regret and horror at the foul acts of their countrymen. Quite so; and the Kaiser, according to his own statement, "wept tears of blood" for poor Servia!

It is surprising that any action should be necessary to remove the names of alien enemies (naturalised or not) from the Roll of the Institution, as, knowing the public feeling in the matter and the diabolical acts of their own countrymen, they should have resigned long ago. We can only assume that, like their fellow-countrymen still in the Fatherland, their hides are too thick to be affected by any amount of castigation. Until the alien enemy is known for what he is worth with all his scheming and plotting, and driven out of the society of decent men, we will set our faces against him, whether he is naturalised or not. We have not the slightest feeling against any individual personally, but we are supporting a general principle, and shall continue to do so even if a few, apparently harmless, are "sent to Coventry."

It is suggestive that the Government of Australia has just given notice that within three months all alien enemies, *whether naturalised or not*, must resign their holdings in any company incorporated within the Commonwealth. All honour to our splendid Colony for setting such an admirable example of patriotism to the mother country, who, we fear, badly needs it.

In conclusion, we re-assert that we are wholehearted for the exclusion of all alien enemies, whether naturalised or not, from the Institution of Electrical Engineers and every other society of true Britishers.

Six Borough Electrical Engineers,
Members of the I.E.E.

P.S.—Since the above was written a notice has appeared in your issue of January 21st that the Council of the Institution has passed a resolution that they are of opinion that Clause 41 of the Articles of Association provides sufficient means for the expulsion of undesirable persons (whether alien enemies or not) from the Institution. We would point out, however, that it would appear that under Article 41 *each case has to be taken separately*, and as this amounts to an attack upon individuals, we strongly object to this being done, as we have stated that we have not the slightest feeling against any individual personally, but are supporting a general principle.

Electrolytic Copper.

May I trespass on your space with just a few lines, even at the risk of repeating myself, in reply to Mr. Welbourn's courteous letter in your issue of January 14th?

His Manchester address was such an able expression of all-round knowledge of the subject that I should not venture to critcise anything except the scientist's tendency to succumb to the attractiveness of a formula.

Hard-drawn copper wire in various sizes is produced by various methods, partly from necessity and partly to suit the convenience of manufacturers, or the purpose for which it is used; consequently, the resulting properties have no fixed relation to the area or to the diameter, and it is impossible to define them by a single expression in terms of either of these throughout the whole range of sizes in use, without considerable inaccuracy at some point or other.

For this reason I have always deprecated the introduction of any formula such as Mr. Pye's as a standard definition, and I am strengthened in my objection by learning that this formula is actually being used by engineers. I think in such case they may, in many sizes, either be contenting themselves with an unnecessarily low grade of wire, or may be adopting a larger factor of safety than is needful, to the detriment of both economy and appearance in their work.

Although I write, as Mr. Welbourn truly remarks, from the point of view of the manufacturer, yet I believe the interests of manufacturers and users are practically identical in this matter, in so far as both want a specification for any given size of wire which will ensure its being the most suitable for its purpose that can be obtained without entailing undue cost or difficulty, either in manufacture or in testing. I do not think that either are particularly interested in a definition which is not capable of being used as such a specification, but may have the appearance of having been so intended. It was for this reason that the Standards Committee agreed to follow my suggestion and to make their *definition* simply a broad statement, marking approximately the dividing line between hard and soft copper, and I fear I must disclaim having any better definition to suggest. If, however, through the collaboration of scientists, users, and manufacturers, a standard *specification* for every size could be drawn up which the E.S.C. could adopt, we should have something of great practical value.

My idea of the procedure would be something on the following lines:—

First collect together a considerable number of samples of wire of each of two sizes, one being comparatively thick, such as 3/0 or 4/0, and the other a thin size, say, 10 or 12 s.w.g., and on each of these sets carry out very complete tests, including breaking stress, elastic limit, limit of proportionality, extension, total elongation on fracture, as well as wrapping and bending tests—(torsion, I think, might be omitted as being somewhat liable to variation through differences of manipulation). An examination of the figures obtained would show how far a definite relation exists between the properties most valuable to users and the simpler tests which can be easily applied without liability to dispute. If the result were satisfactory, a much smaller number of tests on other sizes would be sufficient to establish the standard that might reasonably be asked for in the simple tests selected, and the properties which engineers could rely upon being proved by them.

Thos. Bolton.

London, *January 18th*, 1916.

WAR ITEMS.

After the War Trade.—Speaking at a luncheon given in his honour at Cannon Street Hotel on Friday last, Sir George Reid, M.P., said, as reported in the Press:—"Might he suggest to those whom he was addressing that all the patriotism which they might devote to revising our tariff arrangements and our national trade would not come to much if they did not develop their own intelligence and reform their methods of trade. There was a wonderful slowness about this country. Practical business men were wanted to do spade work for the statesmen, each to go boldly into his own branch of industry, always bearing in mind the needs of the future. And when the spade work was done, then let the Royal Commission come. A multitude of interests had got to be established; and we must first rely on practical experts of British trade to prepare cases for the consideration of the statesmen. There were many men in the City who could render enormous services to the whole Empire by reviewing intelligently and earnestly all the facts of the present and the past in order to enable statesmen to make a really good piece of work of the restoration of the vitality of the Empire." Sir George Reid may take it for granted that if the statesmen of this country are really in earnest in regard to adopting a safe line for the development of the Empire in the future, they will not find the practical trade experts wanting in willingness to place their knowledge at the Empire's disposal. What the Empire will become in the years that follow the war must inevitably be influenced by the new trade and industrial policy that is evolved from all our present discussion and as the result of conferences with the Colonial and Allied representatives.

Registration of Firms Rejected.—In the House of Lords, on January 19th, Lord Southwark moved the second reading of the Registration of Firms Bill. According to the "Times" report, he explained that its object was to secure that every firm carrying on business in the kingdom under a trade name which did not consist of the full names of all the partners without any addition, and every person carrying on business under a trade name containing any name or addition other than the person's full name, should register the name under which the business was intended to be carried on, together with the nature and place of the business, the full name, address, occupation of the person or persons carrying on the business, and the names of any foreign partners. Germans and Austrians trading here were forewarned of the war and took English or French names or some trading name to conceal their origin. It was certainly desirable that trading under assumed names should cease. The practice had developed considerably during the last few months. The Duke of Devonshire said it would be a serious undertaking to compile a register of the kind suggested in the measure, and it would greatly increase the work of the Board of Trade in a time of great pressure. He suggested that the measure should be re-introduced in another Session with a view to its consideration by a Select Committee. The second reading was negatived.

Women Electricians.—Following upon a consultation with various officers of the Labour Exchange on the proposal submitted by him to the Liverpool branch of the Electrical Contractors' Association on the training of a certain number of women in branches of electrical work, Mr. Arthur Angers has submitted his scheme to the Minister of Munitions. In effect, his plan is that women from the age of 20 to 27 or 28 should be employed in the allied electrical trades, for the double purpose, he states, of releasing men to take an active part either in direct military service or else in war work, and of saving an important industry, which in normal times employs thousands of men, from bankruptcy. The positions found for these women must be vacated for the electrician-soldier after the war. The women shall be instructed in electrical work by qualified instructors, and shall, after passing an examination, be paid the same wages as men thus employed. After suggesting other details, Mr. Angers asks for a conference of representatives of the employers and of the Electrical Trades Union to consider the scheme.—"Liverpool Post."

German Capital in Swiss Undertakings.—A step recently taken by the Swiss Government shows that certain aspects of the present war have not failed to impart their natural instruction even in neutral countries. The A.E.G., of Berlin, were holders of shares in the Oberargau-Seeland Railway to the nominal value of 110,000 fr., on which 22,000 fr. were paid up. The Swiss Government have now called upon the railway company to repay this sum, with interest, to the Berlin company, and thus abolish the foreign investment. Similar action has been ordered in the case of a Strassburg company. These steps, it is stated, are taken in the interests of Swiss industry. Commenting on the matter, the Swiss journal "Electro Industrie," which, by the way, declares itself in sympathy with the Central Powers, observes: "Our authorities are beginning to show a true comprehension of the industry of the country and of a national method of thinking and acting."

Engineers Wanted for the Naval Air Service.—The Roval Naval Air Service calls for "skilled engineers, especially those with experience of internal combustion engines, for deferred entry or immediate service."

"Key" Industries.—Speaking at Huddersfield, Sir Algernon Firth, president of the Associated Chambers of Commerce, said, according to the "Times," that the Advisory Committee which had been formed to consider what was necessary to continue the enterprise against German competition, had made its report, and this would shortly be published. Among the industries which had been considered were those in which Germans had specialised and had gained an absolute monopoly before the war. These were the "key" industries which manufactured basic materials so essential to the important industries of this country. The advisory committee had represented in their report to the Government that immediate steps should be taken, by a subsidy or a guarantee of protection to these new enterprises, to develop them by assuring, in the national interest, remuneration to those engaged in them. The committee hoped to extend investigations to other industries which the Germans had specially studied.

Serbian Relief Funds.—To avoid any possibility of confusion in the administration of contributions intended for the benefit of the distressed Serbian population, the Serbian Legation requests that subscriptions intended for the Serbian Relief Fund, of which H.M. the Queen is Patroness, should be sent to the Earl of Desart, K.C.B., at the offices of the fund, 5, Cromwell Road, South Kensington, S.W. The Serbian Legation will continue to receive subscriptions for the following Serbian funds:—The Archbishop of Belgrade's Fund, for the families of the killed and wounded soldiers. The Society of the Serbian Red Cross. The Parliamentary Commission for the Refugees. The Society of St. Helena, for the orphans whose parents have been killed in the war. All contributions addressed to the Serbian Legation (195, Queen's Gate S.W., London) for these funds will be gratefully received and acknowledged.

Australian Metals: The Enemy Control Question.—In the House of Commons, on Monday, Sir Philip Magnus asked the Secretary of State for the Colonies what had been the result of his communications with the Government of Australia respecting measures to carry out the desire of that Government to free the metals of the Commonwealth from enemy control and to encourage their development for the benefit of the industries of Australia and the British Empire. Mr. Bonar Law, in reply, stated that this important subject was one which the Prime Minister of the Commonwealth had telegraphed his desire to discuss personally with him during his forthcoming visit to this country.

Tyneside Engineers and the Dilution of Labour.—At a conference representing Tyneside members of the Amalgamated Society of Engineers, united machine workers, steam-engine makers, and electrical engineers at Jarrow, on Saturday, the Government proposals on the dilution of labour were discussed for three hours on the receipt of a report from the London conference. No resolution was come to on the report, but the meeting criticised the methods adopted by their leaders when they met members of the Government, and passed a resolution thereon.—"Birmingham Daily Post."

Russia After the War.—The "Times" states that the Russian Cabinet has decided to create a Higher Council of Ministers to consider questions relating to the country's economic, commercial, and industrial position in respect of the war.

War Bonus Refused.—The Portsmouth Corporation having decided to adhere to its decision to refuse to grant a war bonus to its employés, the men, who number some hundreds, and, it is stated, include those engaged in connection with the electric light and power system, gave notice that they would cease work on February 2nd unless such bonus were granted.

Germany's Pig-Iron Production.—The German output of pig-iron in December amounted to 1,029,144 tons, as compared with 855,186 in December, 1914, or 33,189 tons per working day, against 27,564.—"Times."

Enemy Trading in South Africa.—A Reuter dispatch from Durban says that an anti-German movement, the object of which is to induce the Government to prevent enemy subjects from trading within the Union, is being vigorously prosecuted.

NEW ELECTRICAL DEVICES, FITTINGS, AND PLANT.

Lamp-Locking Devices.

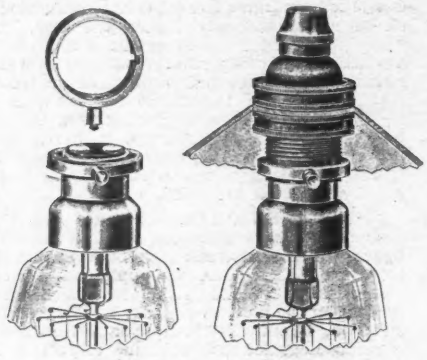
THE EDISON & SWAN UNITED ELECTRIC LIGHT CO., LTD., of Ponder's End, Middlesex, have forwarded us copies of their Leaflets Nos. A 3,128 and A 3,130, dealing with "Lamlok Specialities."

Fig. 1 shows a lamp-locking lampholder which can only be unlocked with a key held by the person responsible for the lighting arrangements. By this means thieving, changing small C.P. for higher C.P. lamps, &c., is eliminated, and a great saving assured to many large public buildings.

It will be seen that a pin passes through a channel in the lamp-holder, and, when locked by turning the key, the rounded end of the pin engages with the lamp cap, thus preventing the upward movement of the lamp necessary to release it from the bayonet catch.

Figs. 2 and 3 show a lamp-locking ring which can be used with any existing bayonet holder, plain or screwed, or batten holder.

FIG. 1. LAMP-LOCKING LAMPHOLDER.



FIGS. 2 AND 3. LAMP-LOCKING RING, SHOWING METHOD OF ATTACHMENT.

Once the lamp is locked it cannot be removed until it is unlocked by the special key provided, which is sufficient to control any number of lamps.

The bayonet pins are engaged with the internal groove on the ring, through the slots in the ring; the lamp is put into the holder, and the ring turned round until the locking-pin is opposite the bayonet-slot, on the holder; the pin is then screwed down into the bayonet-slot with the key provided. When the lamp is securely locked, a small cap is slipped over the boss on the ring.

Mazda Revolving Lamp Shade.

We understand from the BRITISH THOMSON-HOUSTON CO., LTD., of Mazda House, 77, Upper Thames Street, E.C., that they have still available a few of the Mazda revolving lamp shades, such as we illustrate in fig. 4. This effective little advertising device comes to dealers packed in a neat flat packet containing all the necessary parts and simple instructions to enable it to be erected.

FIG. 4.—REVOLVING LAMP SHADE.

The shade proper rests on the tip of the Mazda lamp, the warm air from which, rising through the shade, operates an ingenious fan disk which causes the shade to revolve.

The advertising efficacy of devices in motion is doubtless familiar to readers, and this particular device can be employed, even where lighting restrictions are severe.

American Carbons for Italy.—An American Commerce report says:—"The Catania Street Railway and Lighting Co. has placed an order for 19,400 American light carbons as the result of a Trade Opportunity published in 'Commerce Reports.' This initial purchase of American lighting supplies for Catania is important in that subsequent orders will follow, in all probability, for other cities and towns in the district. As a rule, the difficulty lies in securing the initial order."

LEGAL.

Re ESSEX BATTERY AND MANUFACTURING CO.

ON Friday, before his Honour Sir W. Lucius Selfe, in the Marylebone County Court, Messrs. Napier, Kimber & Co., electrical engineers, Bayswater Road, W., sought to recover £28 17s. 6d., which had been paid to the Essex Battery Manufacturing Co., of Ilford.

MR. ARTHUR KIMBER, one of the plaintiff firm, stated that in November last they had 976 faulty batteries, 411 of which were returned to the company and the balance were waiting to be returned. £30 had been paid. The defective batteries were returned to the defendants, and as they were not redelivered he had made inquiries and found that they firm had gone away.

His HONOUR: What was wrong with them?

WITNESS: We could get no voltage from them. These refills are guaranteed for six months, and in three weeks they were useless. I sent to Ilford to see about the defective batteries, and found the works closed and the firm gone.

His HONOUR: And I expect your money has gone with them. You can have judgment for what it is worth, with costs.

BELFAST SLANDER ACTION.

IN the King's Bench Division, Dublin, before Mr. Justice Madden, Mr. T. W. Brown, on behalf of Mr. Alex. Bryce Farrell, of Ravenhill Park, Belfast, resident superintendent in the central electrical station at East Bridge Street, plaintiff in an action against Mr. Thos. W. Bloxam, chief electrical engineer for Belfast, applied for an order for the discovery of documents. He stated that the action was for slander of, and concerning the plaintiff, in the way of his business. Plaintiff's complaint was that on October 29th, 1915, defendant stated to Alderman Tyrrell and Councillor Duff, at the electrical station: "Main feeder cables in the tunnel in subway were supported and clamped in a manner likely to destroy the cable, and to be a danger of fire in the station, and that Farrell was responsible for this; that cheap cotton 'flex' was used where cables should have been used as a lead for current to a lamp at a small auxiliary engine, and that Farrell was responsible for that; and that Farrell was irreconcilable, and was causing disorganisation in the station, so much so that he (defendant) would prefer to carry on the next two months' work without anyone, rather than with Farrell." The plaintiff said that the works referred to were done under the direct superintendence of the defendant; that defendant signed the order for the materials; and that if anyone was responsible, it was the defendant. The defence, Counsel added, was a traverse of the cause of action, and, in addition, a plea was entered that the communications were privileged.

MR. JUSTICE MADDEN made the order applied for.

PORT OF LONDON AUTHORITY'S APPEAL.

ON Friday the Court of Appeal, composed of Lords Justices Swinfen-Eady, Pickford and Bankes, disposed of an appeal by the Port of London Authority against the refusal of the Lord Chief Justice to enter judgment in their favour in an action brought against them by the widow of an electrician named Blatch, who fell into a graving dock belonging to the appellants, and was drowned. The accident occurred on a dark and foggy night when the deceased was returning from the Millwall Dock, where he had been employed on a ship, in connection with certain electrical fittings. At the trial the jury disagreed, and the defendants applied for judgment. The learned Judge, however, would not accede to this, and the plaintiff set the case down for retrial. The present appeal was advanced so that it might be disposed of before the case was reheard.

Their Lordships allowed the appeal, and entered judgment for the defendants, holding that there was no evidence called by the plaintiff of any breach of duty by the defendants towards the deceased, nor any evidence that the defendants omitted any precautions usually or ordinarily taken by the owners of graving docks.

MUNITIONS CASES.

AT a sitting of the Oldham Munitions Tribunal last week, a local electrical firm complained that a volunteer munitions worker had committed a breach of Sub-Sec. 1 of Sec. 6 of the Act—a Sub-Section which makes it an offence for a munition volunteer who enters into an undertaking with the Ministry of Munitions to act in contravention or not fully to comply with the undertaking. It appeared that the man had been working for the firm for some years, and on January 11th he ceased work and refused to go back, stating that he was tired of the job and felt unsettled. The Trade Union Secretary stated that although the man was a munitions volunteer he had never been "transferred" to the works by the Ministry of Munitions.—Mr. W. Sellers (President): But he was working there when he became a volunteer.—The Secretary stated that there were hundreds in the country similarly situated, but they did not come under Sec. 6 until they were transferred and their war badges were changed. The badge was not changed until the man was transferred.—The employer said he would take the workman back at once, and the Trade Union official said he would advise the man to return.—The President of the Tribunal agreed to a suggestion that he should cause a letter to be sent to the Ministry of Munitions asking for a ruling as to when a man was to be considered transferred. Such a ruling, it was stated, would be of great value in the country.

AN IRISH ARBITRATION.

MR. A. E. PORTE, M.I.C.E., has concluded arbitration proceedings in Dublin concerning a dispute between the Marquis of Sligo and Mr. T. E. Brunker, electrical engineer, Dublin, in respect of an installation of electric lighting in Westport House, Co. Sligo. Mr. Brunker claimed £100 as extras, which were disallowed by the architect, Mr. R. E. Mellon, Dublin, and a sum of £156 was deducted for work alleged not to be in conformity with contract. Lord Sligo counterclaimed for penalties for delay.

The ARBITRATOR said he would inspect the premises before giving his decision.

BUSINESS NOTES.

Wholesale Traders' Association.—The 13th annual meeting of the Wholesale Traders' Association for the Protection of the Hardware, Furnishing and Metal Industries, Ltd., was held at the registered offices, 26, Corporation Street, Birmingham, on January 17th, Major J. H. Cartland, J.P., presiding.

The chairman, in presenting the report and balance sheet, referred to the death of Mr. Thos. Cumberland, who, as late chairman, had presided over the deliberations of the Board since 1902. The operations of the Association had again been fully maintained, and the members had made extensive use of its various departments, which had afforded them exceptional facilities and assistance in many directions in the present crisis. 189 new members had joined the Association during the past year bringing the total membership up to 3,082. The speaker said that notwithstanding the war and the fact that a large number of firms were doing Government work, and, therefore, were not seeking to open new accounts, the number of status inquiries sent in during the year had reached the total of 92,173, thereby showing that there was still a good general trade being done by the various manufacturers and merchants throughout the country, and that a large number of orders had been received from Foreign and Colonial markets, which they were unable to execute at the present time. With regard to the debt recovery department, the number of cases sent in for collection was 19,233 against 18,126 during the previous year, showing an increase of 6½ per cent., and representing a total credit of upwards of £171,000. Out of this sum he was able to report that only about 10 per cent. proved irrecoverable or bad. With regard to the insolvency department, companies' liquidations, &c., a large number of cases were reported to the Association during the year, meetings attended, and action taken in the interests of members. In several instances the result has been an increased dividend for the creditors, and it was essential that members should make the fullest use possible of this department as occasion arose. There was still an impression in the minds of some of the small traders that a sort of moratorium still existed, and that there was no reason to pay their debts. This, of course, was absurd as the only exception now prevailing was that no person should have judgment enforced against him by execution, if there was reason to believe that the debt was owing to adverse circumstances brought about by the war. It was reported that a Bill was shortly to be introduced in the House of Lords for the registration of persons and firms carrying on business in Great Britain and Ireland, and this was a measure which the Association had long advocated through different channels for some time past.

Liquidations.—J. WHITEHOUSE, LTD., 15, The Parade, Golder's Green, Middlesex.—The winding up order in this matter was made on the petition of two creditors, and according to the figures prepared, the liabilities amounted to £993, to meet which there are assets of £917. After deducting the claims of preferential creditors and claims of debenture-holders, the assets were reduced to £167, the estate disclosing a deficiency of £827 as regards the unsecured creditors, whilst as regards the contributories the deficiency amounts to £1,984. It appears that the company was registered on June 23rd, 1914, and was formed to take over as a going concern the business of an electrical engineer, &c., carried on by J. Whitehouse, at 15, The Parade, Golder's Green. The contract for sale to the company was dated August 22nd, 1914, and it provided that J. Whitehouse should sell to the company the goodwill and connection of the business of electrical engineers formerly carried on by J. R. Whitehouse, and the stock, fixtures, plant and book debts, and also the leasehold hereditaments belonging to him, and he agreed to grant a sub-tenancy of his shop at an annual rent of £100. The nominal capital of the company was £3,000 divided into 3,000 shares of £1 each. The company was promoted by Mr. Whitehouse. The property acquired by the company totalled £2,297 odd, while the liabilities were stated to be £1,152 unsecured, the proprietor's capital being £1,145. The trading account for the six months to June 30th, 1914, shows a net profit of £426 odd on a turnover of £1,858, the productive wages being shown at £300, and other drawings and salaries £171. The consideration to be given by the company was, as to part, the allotment to him of 1,155 fully-paid shares in the company, and as to the remainder an undertaking by the company to pay all debts and liabilities of the vendor in relation to the business. The shares were duly allotted to J. Whitehouse, who still holds them. The first director of the company was J. Whitehouse, and he was appointed permanent managing director under the articles. Mrs. Whitehouse is also said to have been a director, but there is no record of how she became one, as she was not nominated under the articles, nor was she elected at any meeting so far as the minute book shows. Mrs. Whitehouse appears to have resigned as a director on August 14th, 1915. By a service agreement with the company J. Whitehouse was to receive a salary of £312 a year and £208 a year for expenses, and on December 20th, 1914, Mrs. Whitehouse was voted a sum of £55 to cover the director's fees and expenses incurred. This sum appears to have been taken to the credit of J. Whitehouse's salary account. The company being a private one, no capital was offered for public subscription nor was any prospectus issued. Mr. Whitehouse holds 1,155 shares in the company, and Mrs. Whitehouse is the holder of one share. From the minute-book, however, it would appear that applications were made for two shares by another person, and it was resolved that these should be duly allotted to him. No share certificate book has been produced. Apparently the company ever since its formation has traded at a loss, there being, in fact, a net loss of £247 on the trading for the first 12 months. The failure is ascribed to stoppage of work owing to the war, although in November, 1914, the company extended it business by taking additional business premises at Child's Hill. Further investigation is to be made into the affairs of the company.

CANADIAN-BRITISH ENGINEERING CO., LTD.—This company is winding up voluntarily with Mr. R. G. Sidford, 20, John Street, Adelphi, W.C., as liquidator. A meeting of creditors is called for February 1st.

SCIENTIFIC MANUFACTURERS, LTD.—This company is winding up voluntarily, with Mr. A. H. Partridge, 3, Warwick Court, Holborn, London, as liquidator.

HELE-SHAW PATENT CLUTCH CO., LTD.—This company is winding up voluntarily, with Mr. W. G. Needham, Holly Bank, Oldham, as liquidator. A meeting of creditors will be held on January 31st, at Hartford Works, Oldham.

AUTOMATIC ELECTRIC BLOCK SIGNALLING CO., LTD.—This company is winding up voluntarily, with Mr. A. Colls as liquidator.

ELECTRIC RAILWAY SIGNALLING SYNDICATE, LTD.—A meeting is called for March 1st, at 32, Great St. Helens, E.C., to hear an account of the winding up from the liquidator, Mr. C. F. Palmer.

Bankruptcy Proceedings.—G. E. BONNER, electrical agent, 105, Fox Lane, Palmer's Green, Middlesex.—Receiving order made January 19th, on debtor's petition.

Book Notices.—"Key to the London Telephone Directory and Business and Trades Directory." Vol. II, No. 2. September, 1915, to April, 1916. London: W. H. Smith & Son. Price 5s. net.

"Annuaire pour l'An, 1916." Paris: Gauthier-Villars et Cie. Price 1 fr. 50.

"The Two-stroke Engine." By Dr. A. M. Low. London: Temple Press, Ltd. Price 1s. 6d. net.

Calendars, Catalogues, &c.—MESSRS. ALFRED GRAHAM & CO., of St. Andrew's Works, Crofton Park, London, S.E., have sent us one of their desk blotting pads, with diary pages interleaved with blotting at the left-hand side. They have also issued their usual useful book of time and speed tables for 1916.

MESSRS. THOMAS WHITTLE & SONS, LTD., Warrington.—40-page catalogue, giving full particulars and sizes of their patent belting, which is a combination of leather and steel links. A large number of excellent half-tone pictures show the application of the belting in the driving of electrical and other machinery.

MESSRS. SIEMENS BROS. & CO., LTD., Woolwich, S.E.—Reprint of pages 903-908 of their Catalogue No. 510, giving revised prices of their jointing materials consequent upon the alterations in cost of materials, &c.

MESSRS. A. G. THORNTON, LTD., Paragon Works, King Street West, Manchester.—Two new catalogues—drawing office and pocket edition respectively—of drawing, surveying and scientific instruments and drawing office materials. The former is a publication of nearly 450 pages, and it contains illustrated descriptions, price particulars, and a telegraphic code, relating to a very complete collection of instruments and equipment. The pocket edition consists of some 160 pp. of material concerning a selection of instruments and materials suitable for draughtsmen and students. The first of these catalogues was in preparation prior to the outbreak of war, and the prices therein are based on pre-war factory costs.

"Z" ELECTRIC LAMP MANUFACTURING CO., LTD., Standen Road, Southfields, London, S.W.—Catalogue No. E 502 giving some particulars of the "Z" drawn-wire lamps and half-watt lamps, also prices of same. The pictures include some views of the stores, the filament winding department, and the test-room at Southfields.

MESSRS. ISENTHAL & CO., Denzil Works, Willesden, N.W.—32-page illustrated catalogue and price list of slate rheostats of many different types, also tubular rheostats. Diagrams of connections are given. The rheostats are of all-British type and manufacture, and they are finding an increasing market in the Allied countries. Two other sections of the catalogue dealing with field, arc lamp resistance, dimmers and special types, are in preparation, and will be issued shortly.

MESSRS. J. H. TUCKER & CO., King's Road, Hay Mills, Birmingham.—Detailed lists of fuse and distributing boards, main switches, and miscellaneous items that are in stock.

THE NOTTINGHAM SOCIETY OF ENGINEERS has sent us one of its pocket diaries for 1916. A full list of officers and members of the Association is given, also a list of kindred Associations, together with a number of engineering advertisements, these preceding a Letts's note-book and diary.

Private Arrangement.—JOSEPH PERCY ANDREW, trading as the Ray Electric Co., 82, Woodgrange Road, Forest Gate, and 350, High Street North, Manor Park, electrical engineer. A meeting of the creditors of the above was held on Monday, at the offices of Messrs. Henry Sydney & Son, solicitors, 185, Aldersgate Street, E.C. A statement of affairs was presented which had been prepared by Messrs. Poppleton, Appleby & Hawkins, and which showed total liabilities of £1,706, exclusive of a claim by the debtor's wife for £55 for money lent. The liabilities included a claim by the debtor's father for £300, money lent, and there were two other cash creditors whose claims aggregated £78, while the claims of the German trade creditors amounted to £309. Mr. E. H. Hawkins stated that the debtor started trading, in partnership, at 339, High Street, Manor Park, in November, 1906. No deed of partnership was entered into, but the debtor and his partner each agreed to put in £100, and the profits and losses were to be equally shared. The debtor's £100 was lent him by his father. The debtor was to draw £1 a week, while the partner was to have £2 weekly. In June, 1908, the partnership was dissolved, and the partner retired. The assets were then valued at £200, and the liabilities at £40, and it was agreed that the outgoing partner should receive £100. The debtor paid £50 of that amount down, and the balance of £50 he borrowed from his father. Since that date the debtor had traded alone. In 1909 the debtor removed to 350, High Street North, the premises being held on a lease at £55, rising to £60 per annum. In 1913 the debtor found he was trading at a profit, and he decided to open another shop at Green Street, Upton Park, where he acquired premises at a rental of £50 per annum. Last December he removed the stock from that shop, and sold the goodwill and his interest in the premises for £40. In March, 1914, still thinking he was making a profit, the debtor opened the Woodgrange Road shop, which he acquired at a rental of £65, rising to £70 per annum. The debtor agreed to spend £300 on improvements to the premises, and had paid £242 for alterations. Mr. Hawkins added that the assets were estimated to realise £568, but from that amount had to be deducted £90 for preference claims, leaving net assets of £478.

In answer to questions, Mr. Hawkins stated that some creditors had obtained judgment against the debtor. During the year ended March, 1913, the sales were £4,098, while in the following year they increased to £6,132. In the next 12 months they were £6,069. Since last March the sales had fallen off somewhat. The drawings had been at the rate of £3 a week.

Mr. Sydney, on behalf of the debtor, made an offer of a composition of 5s. in the £, payable by four equal quarterly instalments, the cash creditors postponing their claims.

Mr. Hawkins said that the money necessary for the payment of the amount of the composition to the German creditors would have to be found by the debtor, and it would then be handed over to the Public Trustee.

Several creditors intimated that they were not prepared to accept 5s. in the £, and Mr. Sydney increased the offer to one of 6s. 8d. in the £, payable by five quarterly instalments. After a short discussion, it was decided to accept the amended offer, and it was also resolved that a deed of assignment should be executed, with Mr. E. H. Hawkins as trustee. A committee of inspection of the principal creditors was appointed. The following are creditors :—

G. G. Bussey	£15	Robin Hood Cycle Co.	£14
East London Rubber Co.	47	Pitco Electric Co.	24
Foster Engineering Co.	21	Walmsley & Sons, Ltd.	16
Elswick Hopper Co.	30	Johnson & Phillips	21
Butcher & Sons	35	Clemens Bros.	36
Summers Bros. & Co.	31	Turner & Burger	12
Dunlop Rubber Co.	15	Jaeger Bros.	162
Times Electric Co.	50	Lohman & Co.	125
New Polyphon Supply Co.	17	H. Feldchenfeld & Co.	65
New Hudson Cycle Co.	12	Stern & Co.	15
Bryans, Ltd.	20		

Trade Announcements.—MESSRS. ELECTRA, LTD., of 1, The Triangle, New Barnet, N., state that they are inaugurating a new scheme of insurance and maintenance of motor-car lighting sets and electrical accessories.

MESSRS. BOVING & CO., LTD., who have now removed to their new premises at Imperial Buildings, 56, Kingsway, London, W.C., have in circulation a booklet containing some excellent views of these premises.

MESSRS. THOMAS & BISHOP have removed to 37, Tabernacle Street, in order to have their general offices, stores and works under one roof. All general correspondence and goods should be addressed there. The accounts departments will continue at 119-125, Finsbury Pavement, E.C.

German Catalogues.—In order that British manufacturers may have an opportunity of familiarising themselves with German methods of publicity, the Board of Trade have collected over 3,000 specimen catalogues of German origin, illustrating a great variety of industries, and these may be inspected at the Foreign Samples Section of the Commercial Intelligence Branch, 32, Cheapside, London, E.C. A complete index of the catalogues has been prepared, rendering identification of any particular catalogue a simple matter. Arrangements have been made whereby catalogues may be lent for a few days to United Kingdom firms established in the Provinces.—*B. of T. Journal.*

For Sale.—The Salford Electricity Committee invites tenders for one Browett-Lindley three-crank, three-cylinder Uniflow engine, direct-coupled to Mather & Platt D.C. generator, and one Browett-Lindley six-cylinder compound engine, direct-coupled to Mather & Platt D.C. generator, both sets complete with jet-condensing plant. Particulars are given in our advertisement pages to-day.

Trade in China : Catalogues Wanted.—H.M. Commercial Attaché at Peking (Mr. W. P. Ker, C.M.G.) reports that the Chinese Ministry of Agriculture and Commerce have recently established a Commercial and Industrial Commission, whose object is the collection of statistics and the development of Trade in China, and that this Commission desires to receive copies of catalogues issued by United Kingdom manufacturers. United Kingdom manufacturers, and exporters of U.K. goods, who may be interested, should address catalogues and price lists of their goods to the Commercial and Industrial Commission, Ministry of Agriculture and Commerce, Peking.—*B. of T. Journal.*

An Inquiry from British Columbia.—MESSRS. P. F. LETTS & CO., electrical engineers and contractors, of 3,044, Granville Street, Vancouver, B.C., wish to receive catalogues, prices &c., from manufacturers of silk shades for electrical table, floor, and candle lamps.

LIGHTING AND POWER NOTES.

Aldershot.—REVISED TARIFF.—The U.D.C. has adopted a revised scale of charges for electricity for power and heating, varying from 2d. per unit for under 250 units per quarter, to 1½d. per unit for over 2,000 and under 5,000 units; beyond this amount a special arrangement will be made. The lighting accounts, as from March 31st, will be increased by 10 per cent.

Argentina.—The municipality of the city of Santiago del Estero has voted $300,000 for the cost of installing a power house for the public supply of electric light and energy.

The latest electrical news of importance from the Argentine Republic is as follows :—The electric light and power installation now in course of construction in the progressive town of Villa Canas, in the province of Santa Fé, will shortly be completed and ready for the inauguration ceremony. The inauguration has just taken place of the electricity station, recently constructed at Monteros, by Messrs. Otonello & Brothers. Proposals have been made to the authorities of Lules, in the province of Tacumany, to light that town from the electric station situated in the neighbouring townships of Concepcion and Tafi-Viejo. The municipality of Colon has received the plans of the projected electric light installation, and so soon as they are approved, the contractors, Messrs. Klug & Hubscher, will begin operations. At Nogoya the large flour-milling company, the Sociedad Anonima Molinos Harineros y Elevadores, have arranged for the equipment of their new mill with electric driving.

Australia.—A majority of the ratepayers of Balaklava, South Australia, has decided in favour of borrowing £3,750 for the purpose of installing electric light. The question was first discussed four years ago.—*Tenders.*

The annual report of the Port Melbourne municipal electric light and power scheme inaugurated two years ago, shows receipts amounting to £4,514, and expenditure to £3,782; the year's revenue included the following :—Private consumers for power, £2,020; for lighting, £1,408; street lighting, £981; the expenditure included £2,403 paid to the Melbourne City Council for electricity. From the year's profit of £752, £239, the debit balance of the previous year, has to be deducted, leaving a profit of £513 for the two years.

The city electrical engineer of Melbourne, in his report on the proposal to install electric lighting in city premises on extended terms of payment running to 30 months, states that the greatest objection to the scheme would be the very large number of bad debts the City Council would be liable to incur. It would also be necessary to obtain legislation allowing the Council to make the payments a first charge on the land. The engineer does not consider the scheme would be availed of to an extent to justify its adoption; landlords would not be willing to bear the expense of the installation even if it were spread over a period without increasing the rents; the only class of property for which he could recommend the scheme would be where the owner was also sole tenant.—*Australian Mining Standard.*

The Wollongong Municipal Council has adopted the plans and specifications of Mr. J. R. Rumford for an electric light installation, the maximum demand being put at 105 KW. Electricity will be supplied from the Department of Public Works power house at Mount Kembla; 28 miles of reticulation are specified. The contractor is providing the installation on terms of payment extending over 10 years.

The Mudgee Electric Lighting Co. has installed a small steam generator set for the day load, and a new battery is to be obtained by the company, which is also in negotiation for a new generator set from South Australia, to take the place of a set ordered in England, and unobtainable owing to the war.—*Sydney Telegraph.*

N.S.W.—ELECTRIC WINDERS.—Two electric winders are in use in the coal mines of New South Wales, one being at the Aberaman Colliery and the other at the Richmond Main Colliery. The first-mentioned is connected through gearing to a 105-H.P., D.C., 250-volt motor, and is used to draw coal from the bottom to the top seam. It is operated by means of a reversible controller and powerful foot-brakes. The winder at Richmond Main is direct-coupled to an 800-volt D.C. motor of 800 to 1,850 B.H.P., and is fitted with over-speed and over-winding gear, also compressed-air brakes. It operates on the Siemens-Ilgner system, a fly-wheel converter set being installed. A clutch is provided so that the

fly-wheel can be put out of gear, and the winder worked on the Ward-Leonard system when the loads are light. As this mine is only in the development stage, no figures as regards the capacity of the winder are available.—*Australian Mining and Engineering Review.*

Aylesham.—E.L. SCHEME.—The P.C., after discussing with Mr. Chas. H. Best, of Bradford, and Mr. Pullan, details of an electricity scheme for the parish, using overhead cables, has passed a resolution welcoming an efficient scheme of electric supply, but without taking any action in the promotion of a company for the purpose. Mr. Best proposes to float a company with a nominal capital of about £3,000, and to supply current for lighting at 6d. per unit, with a substantially lower rate for power and heating.

Bradford.—WAR BONUSES.—The Special Committee appointed to consider the question of war bonuses to the employés of the various departments of the Corporation, has decided to recommend that it is desirable to maintain the principle of dealing with any adjustment of wages during the war by means of war bonuses rather than the revision of the wage standard. The Committee also recommends a revision of war bonuses as follows: 3s. a week for men over 19, where the wages do not exeed £3 a week; 2s. a week for male employés under 19, and female employées 2s. a week all round.

Ballater.—E.L. SCHEME.—Application has been made to the B. of T. by Duncan's Electricity Supply Co., Ltd., for consent to the erection of 220-volt overhead transmission lines throughout the burgh of Ballater, for the purposes of supply under the Ballater Electric Lighting Order, 1914.

Bedford.—Messrs. W. H. Allen, Son & Co., Ltd., have informed the T.C. that they are installing a further 250-KW. motor-generator, so as to enable them to take the whole of their supply from the electricity undertaking, instead of it being necessary to run their own plant as well. The existing mains, it was stated, would be large enough to take the increased demand provided a synchronous motor-generator was installed, and this the firm had agreed to put in. The Council has decided to provide the necessary additional meters and switchgear, at an estimated cost of £130.

Brighton.—PROPOSED TARIFF INCREASE.—At the last meeting of the T.C., the electrical engineer submitted a further report on the situation that has arisen in connection with the electricity undertaking owing to the war. He considers that there will be a possible increase for the year of £8,000 in the cost of coal and a decrease in consumption, together estimated to cause a deficit of over £5,000. The Electricity Committee, on the advice of Mr. Christie, recommended a flat rate of 5½d. per unit for all classes of consumers, excepting for power and tramway supply, subject to reductions of ½d. per unit for each additional 1,000 units after the first 1,000, with a minimum of 3½d. per unit for everything over 4,000. The change is estimated to produce an additional revenue of £12,000, the proposals to take effect from the March quarter. After a long discussion the whole matter was referred back to the Committee.

Chislehurst.—The Foots Cray Electricity Co. has decided to make a quarterly charge of 1s. per meter from January 1st last. The Finance Committee of the U.D.C. reported that although no charge for meters had hitherto been made, the company had adopted this course rather than increase the price of current.

Coniston.—E.L. SCHEME.—The Ulverston R.D.C. has again deferred the question of signing a draft agreement with the Coniston E.L. Co. for a scheme for electric supply in the parish, and decided to submit the agreement to counsel for advice regarding certain clauses.

Continental.—ITALY.—In consequence of the enormous rise in the price of coal in Italy, the municipality of Vercelli has decided to draw upon the hydroelectric works of the Società Officine di Energia Elettrica, of Novara, for current for lighting and power for the period from dusk to dawn, reserving its own steam plant for the remainder of the 24 hours. The position of Vercelli is typical of very many cities in Italy at the present time.

Darlington.—The output of the municipal electricity works for December was 665,127 units, an increase of 29·65 per cent. upon the figures for December, 1914. During the nine months ended December 4,347.064 units were generated, being an increase of 715,482 units, or 19·97 per cent., for the year to date.

Dublin.—A number of motors have been installed in a new factory at Parkgate Street, and will be supplied from the Corporation electricity mains, it being estimated that at least 600 H.P. will be required to keep the factory running. The factory will be in full work by March 1st.

Dungannon.—E.L. SCHEME.—The Provisional Committee for the introduction of public electric lighting proposes to erect the generating plant at a waterfall, at Altmore, about six miles from the town, where riparian owners are giving every facility. The new company will be worked on co-operative lines. Already a considerable sum of money has been subscribed.

Edinburgh.—NEW POWER STATION.—The T.C. has adopted the Electric Lighting Committee's report recommending approval of the plans for the Portobello power station, and that estimates be obtained. The report stated that the cost of the work for which tenders have been accepted was £93,369, and the estimated cost of the remainder of the work was £106,215, a total of £199,584. The purchase price of the site of the station was £15,800, including a certain amount of property which would continue to yield revenue for some years.—*Edinburgh Evening News.*

Eton.—HOSPITAL LIGHTING.—The R.D.C. has accepted the offer of the Electricity Co. to supply current to the isolation hospital at 6d. per unit on a five years' contract. The company recently advanced the price to other consumers to 6½d. per unit.

Fleetwood.—NEW PLANT.—The electrical engineer to the U.D.C. has been authorised to proceed with his scheme for providing apparatus for softening and filtering water from the Clough for the electricity works.

Greenock.—Figures for the output of the Dellingburn electricity works, for the month of December, show 2,568,032 units generated, an increase of 1,104,188 on the corresponding period of last year.

Hull.—The acting city electrical engineer (Mr. McGoris), in the absence of the engineer (Mr. Bell), who is now with the Forces, has prepared revenue estimates of the Corporation electricity undertaking for the financial year ending March 31st, 1917. He estimated that the receipts would be £93,970, and that there would be a balance, after interest on loans and contributions to sinking funds amounting to £35,235 had been met. The estimates were approved. A number of applications for increases of salary were referred to a Sub-Committee for consideration.

India.—The electrical scheme of the Allahabad Municipal Board is making progress, and the company hopes to complete the work by the middle of April next.—*Indian Engineering.*

Keighley.—MOTOR HIRING.—The T.C. has decided to purchase no further motors for letting out on hire, but existing arrangements with consumers already supplied will be continued, and motors returned from hire will be relet to fresh customers.

Letchworth.—The output of the First Garden City Co.'s electricity works for the year 1915 was 907,000 units, as against 582,510 for 1914. During the year considerable extensions have been made, which, when completed, will give a total of 2,140 H.P. of plant installed at the electricity works.

Limerick.—YEAR'S WORKING.—At a meeting of the Corporation it was stated that the electric light works were now paying, a deficit of £1,700 having been wiped out during 1915, and a profit of £500 recorded.

London.—ST. PANCRAS.—On November 24th the borough treasurer submitted a statement of electricity capital expenditure for the year ending March 31st, 1916, showing that sufficient balances are in hand to meet the estimated requirements for the remainder of the year, and that it would be unnecessary to borrow further.

The Finance Committee has received a communication from the L.C.C. stating that the loan of £8,970 last granted was based upon the estimated expenditure in 1914-15 under the head of mains £8,000, and that it now appears that the actual expenditure on mains in that period was £1,057 only; the Council therefore asks the B.C. to repay the sum of £2,587 advanced in respect of estimated expenditure in 1914-15 upon electricity mains (which with £5,413 in hand under this head at March 31st, 1914, made up the £8 000 referred to).

The Finance Committee, in reply to a communication to the L.C.C. as to the urgency of sanction being received for a loan of £13,000 in respect of the King's Road electricity station extension, has been informed by the Controller of the C.C. that his Finance Sub-Committee has agreed that the application should be proceeded with.

The Electricity Committee recommends that the L.C.C. be informed that it is intended to extend the feeder mains in the Northern and Prince of Wales Road district, at an estimated cost of £4.526; and that the £2,587 will be absorbed by this extension. The Finance Committee approves the recommendation.

The Electricity Committee has received a petition from the station mains staff for 15 per cent. increase in their wages in lieu of the present war bonus. The Committee is of opinion that the Council should reconsider the whole question of the war bonus now in operation.

The engineer recommends that the remaining 250 arc lamps be converted for incandescent lighting; he also reports that his amended estimated expenditure for 1915-16 will reduce the amount by £2,395, and the expenditure next year will be further lessened by £750 in respect of the hire of the Ljüngstrom turbine, and £551 for watching the stations, which will not be necessary.

L.C.C.—ELECTRIC COOKING.—The Education Committee has decided to continue for a further period of one year the electric cooking stove installed as an experiment at the Maxey Road (Woolwich) Domestic Economy centre.

The Finance Committee of the L.C.C. has sanctioned a loan of £2,618 to the Battersea B.C. for electricity mains.

Lincoln.—The T.C. has applied to the B. of T. for consent to use overhead lines, in order to supply current to premises at Foss Bank.

Monaghan.—E.L. SCHEME.—A public meeting of ratepayers has authorised the Council to give consent to the Monaghan Lighting Co. to erect poles and wires in the streets for the introduction of electric lighting.

Newbridge (Co. Kildare).—HOSPITAL LIGHTING.—At a meeting of the Governors and friends of the Drogheda Memorial Hospital, it was announced that electric light was being installed in the institution.

Rawtenstall.—Large consumers of electricity for power and lighting have recently asked the Corporation to supply the current for lighting at the same rate as that for power, but the application has not been granted.

Rugby.—The T.C. has agreed to supply current for power purposes to the Rugby Sparking Plug Co., on terms varying from 1½d. per unit for under 10,000 units, to 1d. per unit for over 15,000 units per year.

Swinford (Co. Mayo).—In the annual estimate of expenditure by the clerk of the Union, £140 is allowed for electric lighting of the town in a special area fixed for that purpose.

Wallasey.—In regard to the failure of supply from the new generating station on January 11th, the engineer reports to the Council that it was due to stoppage of circulating water, and the plant was in operation again after three days.

West Ham.—The money now being required for current expenditure, the Finance Committee has recommended the Corporation to apply to the L.G.B. for a consent order authorising the raising of the unexercised balance of £2,000 of the loan of £17,500 granted in January, 1914.

Wigan.—E.L. FAILURE.—The Corporation electricity supply, which had been in a precarious condition all day, failed on Friday evening last. Anticipating trouble, a warning had been issued to consumers during the afternoon and the tramway service suspended. Apparently trouble has arisen owing to the hard water used for boiler feeding purposes and the non-delivery of new boilers, and the Electricity Committee is trying to arrange with the South Lancashire Tramways Co. for a temporary supply of current, as the company's cables practically meet those of the Corporation at Hindley.

It is calculated that the town will lose £1,000 in tramway revenue, in addition to the loss on lighting and power revenue.

Wolverhampton.—PROPOSED LOAN.—The T.C. is making application to the L.G.B. for its sanction to the borrowing of a sum of £1,780 for mains extensions in connection with the supply of electrical energy to certain manufacturers; and also for the Board's permission to the expenditure of £670, out of loans already raised in connection with the same extensions.

TRAMWAY and RAILWAY NOTES.

Argentina.—The inauguration of the No. 12 line of electric tramways at Rosario is reported. This line has been three years in the process of construction.

Ashton-under-Lyne.—FEMALE LABOUR.—The T.C. has granted conductor's licences to 10 females engaged by the Oldham, Ashton and Hyde Electric Tramway Co., Ltd.

Australia.—ELECTRIFICATION OF THE SYDNEY NORTH SHORE LINE.—The tunnel from Long Nose Point to Balls Head is nearly completed, the flooding having been successfully overcome, and it will be possible to lay the cables in a few weeks. At White Bay power house, machinery capable of developing 30,000 H.P. has been installed, and there is room for a further 60,000 H.P., or 90,000 H.P. in all, which is sufficient for the electrification of the whole of the suburban lines. It is estimated that the North Shore system can be electrified for £300,000; it is also considered that the White Bay power house should be utilised at the earliest possible moment for this railway, and that the building of the new electric railway stock should be commenced at once in order to be ready for the conversion of the suburban lines as soon as the power is available.—*Sun.*

SYDNEY CITY ELECTRIC RAILWAY.—The N.S.W. Minister for Public Works has intimated that the construction of the Sydney City Railway will be commenced in March. The plans specify that the overhead station at Circular Quay is to be moved nearer the Customs House, thus providing more room and involving the demolition of the Harbour Trust offices and the metropolitan fire station adjoining.

The Maryborough (Queensland) Council Tramways Committee has considered a report on the electric light and tramways questions, and has decided to pay Mr. E. J. Redmond £50 out of pocket expenses incurred in connection with his recent scheme. A further £50 was authorised to be spent in order to complete the information in connection with an up-to-date electric tramway system.—*Tenders.*

The Victorian Railway Commissioners are applying to Parliament for sanction to a loan of £800,000 towards the electrification of the Melbourne suburban lines, excluding the construction and structural alteration of rolling stock, but including the electrical equipment; the amount is part of the £3,110,000 loan for railway purposes.—*Age.*

The annual report of the Prahran-Malvern Tramway Trust states that the total length of track operated was 27·387 miles double and 3·280 miles single, which would be shortly extended by the completion of the Burke Road tramway. The car depôt and converter station at Kew were nearly completed, and would be available as soon as the battery was in position. In view of existing conditions and the increased cost of materials, it was recommended that no further extensions should be entertained until normal conditions prevailed. The gross revenue was £121,016, and the operating costs £110,493, leaving a surplus of £10,523, to which had to be added £3,168 for the loss on the Caulfield and Point Ormond extensions. The whole of the street lighting of the track was provided by the Trust, at a cost of £3,336. The balance to the credit of renewals, reserves, and sinking fund was £30,966, and the capital expenditure was £654,599. The number of passengers carried during the year was 18,350,503. The receipts on the Caulfield line were £7,226, and the expenses £10,394, leaving a loss of £2,942 to be repaid by Caulfield and £226 by St. Kilda. The transfer to reserve, sinking and loan funds amounted to £11,250, leaving a balance of £1,190 available for distribution as follows:—Prahran, £1,181; Melbourne, £9. During the year £1,050 has been paid to employés who had enlisted with H.M. Forces.

Bingley.—TRAMWAY EXTENSIONS.—The B. of T. has extended by two years, up to February 7th, 1918, the period allowed for the completion of the Bingley tramway past the Ryshworth Hall corner at Cross-flats.

Blackpool.—TRAFFIC RECEIPTS.—The tramway figures for the month ending January 13th show receipts of £3,322, an increase of £497 over the corresponding period of last year, and passengers carried 758,418, an increase of 105,600. The receipts from the commencement of the municipal year amounted to £70,727, an increase of £2,136 over the corresponding period of the preceding year.

Bradford.—TRAMWAY COLLISION.—An accident occurred on the Thornbury section of the Corporation tramways on Thursday morning, last week, when an outward bound Bradford to Leeds car took the wrong points at a crossover road near the Thornbury tram sheds and crashed into a Leeds Corporation car proceeding to Bradford. Nine persons complained of injuries, the most serious cases being removed to the Royal Infirmary.

Continental.—SPAIN.—A scheme has been lodged at the Prefecture of Public Works, at Santander, for the construction of an electric tramway linking the seaside resort of Sardinero with those at Cabo Mayor and Cabo Mener. The line, which will have three branches, will have a total length of 3,618 m.

ITALY.—As far back as April 14th, 1914, the Consiglio Comunale of Spezia decided to exercise its legal right and take over the tramways owned by the Società Tranvie Elettriche della Spezia. Differences of opinion, however, existed between the company and the Commune as to the amount to be paid as compensation and for the plant, 2,469,130 lire and 4,500,000 lire representing the purchaser's and the seller's estimates respectively. The matter is now to be referred to arbitration for settlement.

In view of the near lapse of the concession enjoyed by the Società Romana Tramways-Omnibus, the Administration of the Municipal Tramways is drafting a broad scheme of tramway extensions and street improvements conjointly, which is to be undertaken when the whole of the city's network is under municipal control. Ten new lines are to be carried out and the Administration intends to "unfold a plan of underground tramway lines of moderate depth which will represent an intermediary stage between the existing aboveground network and the deep 'tube' line of the future, which must be constructed when the population of the city amounts to 1,000,000." The provisional moderate depth underground lines are, it is stated, an actual necessity, owing to the daily growing congestion of traffic in the streets of the city. The 10 new lines projected are to be constructed gradually, preference being given to radial trunk lines and the most active traffic routes. The total length of the new lines projected is upwards of 2,127 km.—*Rivista Tecnica d'Elettricità.*

Croydon.—FEMALE LABOUR.—The B.C. has authorised premises being rented to provide messroom and waiting accommodation for women conductors, of whom nine are being trained. It is reported that the receipts to date exceed by £5,332 those of the corresponding period of last year. The Committee has considered the suggestion of the Croydon Chamber of Commerce that a parcels delivery service should be tried but, owing to shortage of labour, did not consider it advisable or practicable.

Dover.—The T.C. has appointed a Sub-Committee to consider the question of women conductors, and to take the whole question of the tramways into consideration. The aggregate revenue of the undertaking from April 1st last amounts to £12,944, as compared with £10,730 for the corresponding period of the previous year.

Dudley.—INQUEST.—The inquest relative to the death of J. T. Evans, which resulted from injuries received in the tramway accident, mentioned last week, was opened on Thursday, last week. After evidence of identification, the inquiry was adjourned to February 3rd.

Ealing.—Owing to the bursting of a water main on Sunday, between Ealing Station and the Broadway, considerable damage was done to the roadway, causing the London United Tramway service to be suspended.

Edinburgh.—The Tramways Committee of the T.C. recommends the provision of a motor for driving certain machinery at Shrubhill power station, at an estimated cost of £160.

London.—The traffic receipts of the L.C.C. tramways during the five weeks ended January 12th, 1916, amounted to £228,425, and the number of passengers carried to 54,291,778; for the corresponding period of 1914-15 the receipts were £221,174, and the passengers carried 52,860,313, showing an increase of £6,251 in the receipts, and 1,431,465 in the number of passengers carried.

SOUTH-WESTERN ELECTRIFICATION.—The difficulty which prevented the electric train service on the Waterloo to Kingston, Richmond, and Shepperton lines, on the L. and S.W. Railway, from being inaugurated on December 5th has now been overcome, and it is officially announced that the service will commence on Sunday, January 30th.

Manchester.—TROLLEY BOYS STRIKE.—The tramway department has recently experienced a shortage of boy labour, and, by way of experiment, four girls have been engaged as "trolley-girls." The trolley boys, being under the impression that the girls were receiving better pay than they were, went on strike at noon on Friday last week, their "demand" being that they should have an advance. Mr. J. M. McElroy, general manager, stated that he had received no application from the boys for an advance of wages. The trolley girls, he added, were being paid on exactly the same scale as the trolley boys. Ald. Jackson, of Salford, general secretary of the Tramway Workers' Union, said the boys ought not to have taken the law into their own hands, and his Union could not sanction such action as they had adopted. The trolley boys returned to work on Saturday. Altogether about 350 trolley boys are employed on the tramway system.

TELEGRAPH and TELEPHONE NOTES.

Argentina.—A concession for the installation of a new public telephone service at Buenos Ayres has been granted by the Municipal Commission of the City to Senor Alex. Schwimmer. The system is intended to provide news and electrophone service, and the concession lasts 30 or 50 years; the concessionaire will pay 6 per cent. of his gross receipts during 30 years, and 12 per cent. during the remainder of the term, to the municipality, with a fixed minimum annual payment of 50,000 Mexican dollars, and the maximum price per subscriber's station is fixed at $10 per month.

New Wireless System.—It is reported from Madrid that a new wireless telegraph system will be put in operation between Corunna and New York from February 1st. The system has been invented by Senor Branas, Professor of Oviedo University.

Russia and Rumania.—The Great Northern Telegraph Co., of Denmark, announces that an urgent service with Russia and Rumania has been introduced. The word "Urgent" must be inserted before the address and be paid for. The rate is triple ordinary rate—viz., to Russia 1s. 1½d., and to Rumania 1s. 3d. Urgent telegrams will receive priority of treatment over other private telegrams.

Week-End Messages to Australasia.—The Pacific Cable Board announces that during the suspension of week-end messages between the United Kingdom and Australasia (owing to interruptions on the Atlantic Cable system), messages will be accepted for transmission by post to Montreal and telegraphed from thence to destination, at the rate for week-end messages from Montreal to Australasia. Telegrams sent by this service will probably reach their destination in about 12 to 16 days, the period depending on the mail service between this country and Montreal, and may be posted to the Pacific Cable Board, Queen Anne's Chambers, London, S.W., together with remittance covering the cost at the following rates:—To Australia, 20 words, minimum charge, 11s. 8d.; each additional word, 7d. To New Zealand, Norfolk Island and Suva (Fiji), 20 words, minimum charge, 10s.; each additional word, 6d.

Messages must be prefixed P.W.T., which is counted and charged for as one word. These telegrams may also be handed in or posted to any of the offices of the Western Union Telegraph Cable system.

An arrangement is already in force in Australia and New Zealand for the acceptance of week-end messages to be telegraphed to Montreal, and posted thence to their destination in the United Kingdom.

Women Wireless Telegraphists.—A woman correspondent of the *Times* recently discussed the opportunities open to women to obtain employment in connection with wireless telegraphy. Already women are working on stations in the British Dominions and the United States, and the British Government has placed women in charge of stations at Rathlyn Island and the Isle of Mull; it is stated that the work is well within the compass of women, who make apt students and readily acquire the technical knowledge necessary to enable them to perform the duties of the wireless telegraphist.

CONTRACTS OPEN and CLOSED.

OPEN.

Australia.—February 18th. Melbourne, Brunswick and Coburg Tramways Trust. Six radial trucks.*

April 15th. P.M.G. Common-battery multiple switchboard, or automatic or semi-automatic switchboard, and associated apparatus. See "Official Notices" December 31st.

BRISBANE.—February 28th. Deputy P.M.G. Gas engine, generator, battery, power board, &c., for the Post Office, Townsville, Queensland. (Schedule No. 370.) High Commissioner's Office, 72, Victoria Street, S.W.

April 26th. Deputy P.M.G. Five sections of trunk line switchboard for Toowoomba Exchange. (Schedule No. 342.)

MELBOURNE.—February 16th: 51 electric staff instruments. February 23rd: Two commutator slotting machines, for the Victorian Railway Commissioners.*

February 2nd. Agent-General for Victoria. Fuse distribution boxes and fuses, for the Victorian State Railways. See "Official Notices" January 14th.

March 22nd. Thermo-electric pyrometers, for the Victorian Government Railway Commissioners.*

SYDNEY.—February 7th. Metropolitan Board of Water Supply and Sewerage. For No. 1 pumping station at Ultimo. Two centrifugal pumps and electric motors (4,000 gallons per minute each), switchboards, starters, &c. Contract No. 1,301.*

February 28th. Municipal Council. Tenders for induction regulators. Specifications (11s. 6d.) from the Electric Light Department, Town Hall, Sydney.

April 10th. Municipal Council. Supply, laying and maintenance for six months of six 11,000-volt submarine cables, each 400 yards long, across Darling Harbour.*

May 3rd. N.S.W. Railways and Tramways Department. One 2,500-KW. turbo-alternator, for Zara Street, Newcastle, power house. Specifications (20s.) from the Engineer's office, 61, Hunter Street, Sydney.

Birmingham.—February 8th. Twelve months' supply of electrical stores, for the Birmingham Tame and Rea District Drainage Board. Forms of tender from the Board's offices, Tyburn, Birmingham.

Great Yarmouth.—February 1st. Corporation. Three, six or twelve months' supply of tramway stores. Specification from Mr. F. L. Turner, General Manager, Tramway Offices, Caister Road.

Halifax.—February 14th. Corporation. Twelve months' supply of electric lighting fittings and accessories, cables, telephone wire, meters, &c. See "Official Notices" January 21st.

Leicester.—February 5th. Corporation. Thirty tons 7-in. steel girder tramway rails, for the Tramways Committee. Particulars from Mr. E. G. Mawbey, Borough Engineer, Town Hall.

Leigh (Lancs.).—February 18th. Electricity Committee. 2,000-KW. turbo-alternator, 6,600 volts; surface condenser, set of pumps, 1,000-KW. rotary or motor-converter, with switchgear. See "Official Notices" to-day.

London.—BERMONDSEY.—February 10th. B. of G. Twelve months' supply of electric lamps. Forms of tender from Mr. E. Pitts Fenton, Clerk to the Guardians, 283, Tooley Street, S.E.

ISLINGTON.—February 17th. B. of G. Alteration to wiring, provision of switchboards, motor starters, &c., provision of motors, and purchase of old plant. See "Official Notices" to-day.

Manchester.—February 8th. Tramways Committee. Motor-'bus engines and chassis. Mr. J. M. McElroy, General Manager.

February 15th. Corporation. General stores, including cables, telephones, electrical accessories, &c., for the Tramways Department. See "Official Notices" to-day.

Middlesbrough.—February 7th. Corporation. Twelve months' supply of electric lamps. Specification from Mr. S. E. Burgess, Borough Engineer.

New Zealand.—AUCKLAND.—February 23rd. City Council. Centrifugal pumping electric motors, and automatic starting and controlling apparatus, for the four city pumping stations. Specifications from the office of the Water Board, Town Hall, Auckland.

DUNEDIN.—May 17th. City Council. (1) Tramcar bodies; (2) electrical equipment. Plans, &c., from the Town Clerk, Dunedin.

RAETIHI.—March 14th. Town Board. 40-H.P. hydro-electric generating set, switchboard, &c. Plans and particulars from Messrs. H. W. Climie & Son, Raetihi.*

WELLINGTON.—March 8th. Public Works Office. One 3,000-KW. generator and one 4,300-H.P. water turbine, at Lyttelton, for the Lake Coleridge electric power scheme. Specifications, &c., may be consulted by British firms at the office of the High Commissioner in London for New Zealand, at 13, Victoria Street, S.W.

Pembroke (Dublin).—February 7th. U.D.C. Twelve months' supply of electrical goods. Specifications from the Town Hall, Ball's Bridge, Co. Dublin.

Ross.—X-rays installation at the dispensary and cottage hospital. Superintendent.

Swansea.—February 7th. Electric light installation, Brynmill School, for the Borough Education Committee. Mr. A. W. Holden, Clerk, 9, Grove Place (returnable deposit of £1 1s.).

Wigan.—February 6th. Tramways Committee. Twelve months' supply of tramway stores, including overhead material, &c. Specifications from Mr. F. Buckley, General Manager, Corporation Tramways, Market Place.

Specifications for the items marked * can be seen at the Board of Trade Commercial Intelligence Branch in London.

CLOSED.

Australia.—The following tenders have been accepted :—

P.M.G.'s DEPARTMENT, SYDNEY.

130 cable boxes, 23 pairs, £146 ; 73 ditto, 39 pairs, £81.—O. Dorbauer.

P.M.G.'s DEPARTMENT, SOUTH AUSTRALIA.

30 miles rubber-insulated copper wire, No. 18, L.S.W.G., £244 ; 25 miles, No. 22, £105 ; 3 miles cotton-covered flame-resisting wire, £30.—W. T. Henley's Telegraph Works Co., Ltd.
60 miles twisted-pair, V.I.R., No. 20 copper wire, £1,158.—British General Electric Co., Ltd.

VICTORIAN RAILWAYS.

15-ton electric crane, including accessories and power derricking gear, £1,596.—Gibson, Battle & Co., Ltd.
60,000 flame arc carbons, £12 per 1,000.—Aust. Otis Engineering Co.
Electric lighting material for cars, at rates.—Aust. General Electric Co.
Two armature-banding machines, £340.—Gibson, Battle & Co.

—*Tenders.*

The Commonwealth P.M.G. has accepted the contract of the Commonwealth Art Pottery and Insulator Co. for the supply of 400,000 B insulators, to be delivered at the rate of 34,600 per month.—*Sydney Daily Telegraph.*

Cape Town.—Tenders were recently invited locally and in England for X-ray apparatus proposed to be installed at the new Somerset Hospital as a memorial to the late Sir Alfred Thompson, M.D. The tenders were submitted to Dr. Reynolds, the radiographer to the hospital, and on his advice the committee has accepted the tender of the British General Electric Co., Ltd., of Cape Town, at £386. The tender includes delivery and erection at the hospital and maintenance for three months.

The contract secured by Messrs. Sykes & Co., and mentioned in our last issue, was secured on behalf of Messrs. Bruce Peebles and Co., Ltd. It was for a Peebles motor-converter manufactured under the Peebles-La Cour patents, not a rotary converter. The Cape Town Corporation already has two 1,000 KW. Peebles motor-converters installed, and the present order is for a third of similar output.

East Ham.—The Electricity Committee has accepted the offer of Messrs. E. & A. Shadrack to supply 100 tons of Sherwood 1-in. nutty slack, at 22s. 3d. per ton, and 100 tons of Glasbrook best Admiralty smokeless Welsh coal, at 31s. per ton.

London.—ST. PANCRAS.—The Electricity and Public Lighting Committee has recommended the following tenders in connection with the extension of the King's Road generating station :—Concrete coal-bunkers and lift well : Messrs. W. King and Son, £2,764. Steel construction work : Messrs. E. C. & J. Keay, £7,615. Coal and ash-handling plant : Messrs. Strachan and Henshaw, £3,660.

ISLINGTON.—The Lighting Committee has communicated with contractors where, in its opinion, it would be in the Council's interest that existing contracts should be continued for a further period of 12 months, with a view to ascertaining which contractors would be willing to agree thereto. The only firm who are prepared to meet the Council in this respect, so far as contracts relating to the electricity department are concerned, are Messrs. Wm. Geipel and Co., who supply arc lamp carbons. The Council has been recommended accordingly.

New Zealand.—The Public Service Stores Tender Board, Wellington, has received the following tenders for 10,000 dry cells for telephones :—

Electric Construction Co.	(accepted)	£541
" "		574
A. & T. Burt .. "		588
F. W. Markman		578
P. R. Baillie & Co.	(for 5,000 only)	419
A. Ellis & Co., Ltd.		625
" "		706
D. Riley & Co., Ltd.		666
Ramsay, Sharp & Co., Ltd.		750

The following tenders were also received for 1,000 yards of silk-covered cable, 33 wires ; 2,000 yards of silk and cotton-covered cable, 66 pairs, and 2,000 yards ditto, 64 wires :—

Turnbull & Jones	(accepted)	£653
British General Electric Co.		584
A. D. Riley & Co., Ltd.		631
P. R. Baillie & Co.		688

—*New Zealand Shipping and Commerce.*

Walthamstow.—The tender of Messrs. W. T. Henley's Telegraph Works Co., Ltd., has been accepted by the U.D.C. for the supply of low-tension cables.

FORTHCOMING EVENTS.

North-East Coast Institution of Engineers and Shipbuilders.—Friday, January 28th. At 7.30 p.m. At Bolbec Hall, Newcastle-on-Tyne. Ordinary general meeting.

Association of Mining and Electrical Engineers (Notts and Derbyshire Branch).—Saturday, January 29th. At 3.30 p.m. At University College, Nottingham. Papers on "Unusual Breakdowns in Colliery Electrical Plant," by Mr. R. Devine, and "Notes on Experiments with Battery Signalling Bells following the Senghenydd Explosion," by Mr. G. M. Harvey.

Rontgen Society.—Tuesday, February 1st. At 8.15 p.m. At the Institution of Electrical Engineers, Victoria Embankment, W.C. Discussion on "The Injurious Effects produced by X-rays," to be opened by Dr. Sidney Russ.

Institution of Electrical Engineers (Students' Section).—Wednesday, February 2nd. At Victoria Embankment, W.C. Paper on "The Methods employed for the Wireless Communication of Speech," by Mr. P. R. Coursey.

Chemical Society.—Thursday, February 3rd. At 8 p.m. At Burlington House, Piccadilly, W. Lecture on "The Recent Work on X-rays and Crystals and its Bearing on Chemistry," by Prof. W. H. Bragg, F.R.S.

Royal Institution of Great Britain.—Thursday, February 3rd. At 3 p.m. At Albemarle Street, Piccadilly, W. Lecture on "Industrial Applications of Gaseous Fuels derived from Coal," by Prof. W. A. Bone, F.R.S.

Greenock Electrical Society.—Friday, February 4th. At 7.45 p.m. At the Temperance Institute, 19, West Stewart Street. Paper on "Colliery Electrical Installations," by Mr. R. Gordon Campbell.

West of Scotland Iron and Steel Institute.—Friday, February 4th. At 7.30 p.m. At the Rankine Hall, Elmbank Crescent, Glasgow. Paper on "The Manufacture of Ammonium Nitrate, &c., from Waste Gases," by Mr. E. Kilburn Scott.

NOTES.

Diesel Engine Users' Association.—At the January meeting of the above Association, the use of tars and tar oils as fuel for Diesel engines was discussed. Mr. Charles Day, of Messrs. Mirrlees, Bickerton & Day, had been specially invited to attend this meeting, and, after referring to the recent very great increase in the price of fuel oil, he said that tars and tar oils had been successfully used on the Continent, the ignition difficulties having been completely overcome by injecting a small quantity of petroleum oil into the cylinder of the engine slightly in advance of the tar oil.

Mr. Day estimated that the cost of carrying out the necessary alterations to engines manufactured by his firm for adapting them to the use of tar oils, including a new needle valve casing, ignition pump, and device for controlling the pump, would be in the neighbourhood of £1 per H.P., and, taking petroleum oil and tar oils at present prices, the cost of this alteration would be paid for in the first year by the saving effected in the cost of fuel oil on an engine working for the average number of hours per annum. He had run Diesel engines quite successfully on whale oil.

On the invitation of the President to give some information on the subject of the crosshead type of Diesel engine being made by Messrs. Mirrlees, Bickerton & Day, Ltd., Mr. Day explained that its advantages, as compared with the trunk piston type, were, in the first place, the greatly reduced risk of piston seizure, due to the fact that the piston need not be such a close fit, as the transverse forces due to connecting-rod angularity were taken on the crosshead, and not on the piston. There was also reduced risk of piston cracking, and it was possible to give much better support in the crosshead type than in the trunk type to the centre of the piston, which was exposed to the greatest heat and to the maximum stress. Trouble with the connecting-rod top end would also be reduced, since this bearing was in a position quite away from the heat of the piston. To secure that the piston-rod should be kept cool, and to prevent any oil vapour rising from the crank chambers to the cylinders, or any smoke or dirty oil passing into the crank chamber, a cover was fitted between the cylinder and the crank chamber, with a water-cooled gland, which prevented transmission of heat to the crosshead. A further advantage was greater economy in lubricating oil, as any carbon or dirty oil was prevented from entering the crank chamber from the cylinders ; the lubricating oil therefore retained its condition longer, not being splashed or thrown on to the cylinder walls, and was kept much cooler, and none of it being lost through the cylinders, a substantial saving would obviously result. The air on its way to the cylinders was arranged first to go underneath the pistons, so that any smoke or gas which had passed the pistons would be thoroughly cleared away, and a considerable amount of air cooling would also take place. The water-cooled gland mentioned would have none of the disadvantages of a water-cooled piston, since it did not introduce any additional reciprocating weight, and its stationary water joints would not be liable to cause trouble. The piston need not be made so thick and heavy as the trunk piston, which was liable to cracking and distortion if its thickness or weight were further reduced.

The next meeting of the Association will be held on February 23rd.

Appointments Vacant.—Chief clerk (temporary), (50s.), for the Corporation of Swindon electricity and tramways department ; test-room assistant and meter mechanic (45s.), for Borough of Newport (Mon.) electricity department ; station engineers (60s.), linemen jointers (50s.), wiremen (40s.), engine drivers (steam, gas or oil), 30s., and wiremen's mates (30s.), for the Military Camps, Western Command. See our advertisement pages to-day.

Institution and Lecture Notes.—Association of Mining Electrical Engineers.—A joint meeting of the Scottish branches of this Association and the National Association of Colliery Managers, together with the Mining Institute of Scotland, was held at Glasgow on Saturday last. Prof. Daniel Burns, of the Royal Technical College, Glasgow, read a paper on "Electrical Shaft Winding," and said that in general the wider application of central supply schemes and the electrical equipment of groups of mines must inevitably lead to a more extensive use of electrical winding, but even the most sanguine advocate of the use of electrical appliances about collieries must recognise that many large colliery concerns produced a large quantity of low-grade fuel from their coal-cleaning processes, which was almost unmarketable, and had to be used for steam-raising purposes at the colliery in order to get rid of it. The necessity of thus having to dispose of the residue of the coal washer must, and probably always would, exert a powerful influence on the cost of steam raising, and would provide in many cases a factor in favour of steam winders which was entirely outside the merits of the two systems. Prof. Burns, in conclusion, remarked that the employment of electricity for winding had now been perfected, and colliery owners need have no hesitation in adopting this type of electrical machinery when suitable conditions existed for its application.

From the foregoing report, extracted from the *Glasgow Herald*, it would seem that some colliery owners are content to use their boiler furnaces as refuse destructors in preference to employing the most efficient means of raising coal. The economic folly of this policy needs no demonstration. How to avoid it may be learned from a visit to the North-East Coast.

Institution of Electrical Engineers.—On Thursday last week a paper was read by Mr. H. H. Harrison on "The Principles of Modern Printing Telegraphy," and a discussion followed.

The same paper was read and discussed at a meeting of the MANCHESTER LOCAL SECTION on Tuesday last. The President of the Institution, Mr. C. P. Sparks, was present and addressed the members, expressing his pleasure at being there. He said that a good deal of agitation and correspondence in the Press had taken place on the subject of "Alien Enemies." The Institution had power to deal with this question under Article 41 if the matter was raised by 10 members, but the matter had not been raised by any 10 members. The Council, however, had appointed a Committee of vice-presidents to consider this matter, and would act within a very short time.

Dealing with the work of the Institution generally, he mentioned the Research Committee. Considerable sums had been set aside for it, with the approval of the members, and good work had been done. Recently, at the request of a Committee of the Privy Council, they presented a report naming nine subjects on which they considered research should be undertaken. Up to the present the Privy Council had only considered two of the nine subjects, and he was pleased to say that the Government had granted the sum of £1,050 per annum towards the cost of research on these subjects. There was no reason to think that the other seven subjects would not receive similar treatment.

The Wiring Rules Committee had completed its work, and he hoped the revised rules would be published within a few weeks.

Dealing with the question of examinations, the President said it was not the wish of the Council to keep out any desirable candidate. If a person could not pass examinations, but was otherwise qualified, and could pass other tests, he would be elected. During the war period the examinations were suspended, and those candidates who were on active service or engaged on munition work would be elected Associate Members at an early date. A hearty vote of thanks was accorded to the President for his address.

Fatality.—A boy while on his way to school at Nitshill, Renfrewshire, came into contact with a fallen live wire of the Clyde Valley Power Co. and was instantaneously killed.

Volunteer Notes.—ENGINEERING INSTITUTIONS' VOLUNTEER ENGINEER CORPS.—Orders for week commencing January 31st, 1916.—By Lieut.-Col. C. B. Clay, V.D., Commandant.

Drills, 6.25 to 7.25; 7.25 to 8.25 p.m.

Saturday, January 29th.—Uniform Parade, 2.45 p.m.

Monday, January 31st.—Sections 1 and 2, Technical; Sections 3 and 4, Lashings and Trestle Bridging, Signalling Class and Recruits.

Tuesday, February 1st.—School of Arms, 6 to 7 p.m.

Thursday, February 3rd.—Shooting for Sections 3 and 4.

Friday, February 4th.—Sections 3 and 4, Technical; Sections 1 and 2, Lashings and Trestle Bridging; Signalling Class and Recruits.

Saturday, February 5th.—Adjutant's Instruction Class at 2.30 p.m.

E. G. FLEMING,
Company Commander and Acting Adjutant.

3RD BATT. (OLD BOYS) CENTRAL LONDON REGIMENT (VOLUNTEERS).—Battalion Orders by Colonel S. G. Grant (Officer Commanding), Thursday, January 27th, 1916:—

Week-end Parades.—Saturday—The Battalion, less Platoons Nos. 6, 9, North London and Blackheath, will parade at Wembley Park at 3.15 p.m. All "Derby" recruits will parade with this party. The members of the Officers' Instruction Class will also parade at Wembley Park at 3.15 p.m., under the Battalion Sergt.-Major.

Sunday.—The Battalion, less Platoons Shooting at Acton, will Parade at the Low Level entrance, G.E.R., Liverpool Street Station, at 9.30 a.m., and will proceed by train for Entrenching duties. Members will carry their own lunch. The Battalion will return to town about 6 p.m.

Musketry.—The Inter-Platoon Competition will be continued on Saturday next, the 29th inst., and on Sunday, the 30th inst., in accordance with the orders published on Monday last. The competing platoons to parade punctually, in uniform with bayonets, at the hours named in the before-mentioned orders.

A. G. JOINER, *Major and Adjutant*, O.B.C.

National Trade Policy.—In the House of Commons on Wednesday, Sir A. Spicer asked the Prime Minister whether the Government were prepared to appoint at once a number of small committees to undertake, for the leading industries of the country, inquiries similar to those recently made by the special sub-committee of the Advisory Committee on Commercial Intelligence of the Board of Trade, and to appoint upon the report of such committees a Royal Commission, representative of various schools of fiscal opinion and of the leading oversea Dominions and India, to make recommendations as to the commercial policy of this country consequent upon the war.

According to the *Daily Telegraph*, Mr. Runciman, who replied, said he proposed to arrange for inquiries similar to that in question to be taken shortly in a number of groups. He was not in a position to state what subsequent action would be taken.

In reply to a request from Sir Philip Magnus for delay, Mr. Runciman said, "Some of these things cannot wait."

Educational.—UNIVERSITY COLLEGE, LONDON.—Owing to circumstances arising out of the war, Mr. Kilburn's Scott's course on the "Electrical Production of Nitrates for Fertilisers and Explosives," announced to begin on Wednesday, January 26th, will not be held.

Patents and Alien Enemies.—The Worthington Pump Co., Ltd., has applied to the Board of Trade for the avoidance or suspension of Patent No. 19,609/10, granted to Meyer, in respect of valves for pumps.

OUR PERSONAL COLUMN.

The Editors invite electrical engineers, whether connected with the technical or the commercial side of the profession and industry also electric tramway and railway officials, to keep readers of the ELECTRICAL REVIEW *posted as to their movements.*

Central Station and Tramway Officials.—The East Ham Tramways Committee propose to increase the salary of Mr. T. C. WINGFIELD, works superintendent, from £250 to £275 per annum.

The Luton T.C. has been recommended to increase the salary of the electrical engineer's chief clerk, Mr. R. HARDING, from £130 to £143 per annum.

The Poplar B.C. has been recommended to increase the salaries of the following officers of the electricity department as from January 1st:—Mr. F. TAIT, assistant manager, £275 to £287 10s.; Mr. V. H. CRUICKSHANK, station engineer, £250 to £262 10s.; Mr. E. R. INGRAM, mains engineer, £250 to £262 10s.; Mr. E. E. FARRANCE, sales manager, £237 10s. to £250; Mr. A. H. VINCENT, junior clerk, £71 10s. to £78; Mr. J. FORSYTH, charge engineer, £175 to £185; Mr. C. W. COPPINGER, charge engineer, and Mr. A. E. RICKETTS, sub-station engineer, £162 10s. to £185 each.

Mr. G. SCHOFIELD, late constructional superintendent of West Ham Corporation, has concluded his services with West Ham and taken the position of chief assistant engineer to the Nairobi Power & Lighting Co., Nairobi, East Africa. He sailed on the ss. *Comrie Castle*, which left Marseilles on January 25th.

General.—Mr. C. G. STANESBY, F.C.I.S., has been appointed secretary of the Charing Cross, West End & City Electricity Supply Co., Ltd., in succession to Mr. Edward Wilmot Seale, who has retired after 26 years' service.

The *London Gazette* contains the following notice:—"Territorial Force: The London and Tyne Electrical and Mechanical Company. The announcement of the transfer of the undermentioned officers, which appeared in the *London Gazette* of December 1st, 1915, is cancelled:—Captain (temporary Major) Arthur E. Levin; Second-Lieutenant (temporary tain) Hugh C. C. Tufnell; Second-Lieutenant (temporary tain Hugh C. C. Tufnel; Second-Lieutenant (temporary Lieutenant) Frederick H. Bowers."

Mr. G. A. MENSHALL, leading electrical fitter and machinery attendant on the staff of the L.C.C. Highways Committee at Rotherhithe tunnel and Deptford Creek bridge, has resigned.

Mr. W. H. WALTON, late of the staff of the electricity department of the Marylebone T.C., and formerly at Blackpool Corporation works, has obtained a commission in the R.N.V.R. He has been in the Anti-Aircraft Corps, and served for five months at the Dardanelles.

Mr. C. W. SALT, borough electrical engineer at Torquay, who recently joined the London Corps of Electrical Engineers, has been promoted to the rank of corporal.

The electricians and other members of the engineering staff of Messrs. M. Oldroyd & Sons, Ltd., woollen manufacturers, of Bradford Road, Dewsbury, last week presented an illuminated address and gold watch to Mr. G. H. HARROP, on his

retirement after 32 years' service with the firm. Mr. Harrop has been chief engineer to the firm for 23 years.

In the absence of the President of the Royal Society of Arts, H.R.H. the Duke of Connaught and Strathearn, K.G., Dr. Dugald Clerk, F.R.S., Chairman of the Council, on Monday afternoon, at a meeting of the Council, presented the Society's Albert Medal to Prof. Sir J. J. THOMSON, O.M., D.Sc., LL.D., F.R.S., "for his researches in chemistry and physics, and their application to the advancement of arts, manufactures, and commerce."

Mr. ERIC SMITH, who has just joined the Electrical Signalling Department, Cable Company, Canadian Contingent, was electrical engineer on the Santa Fé Railway, and was at New Mexico, U.S.A., before coming home to join the Forces.

Mr. S. R. BOOTH has been appointed to the staff of the Adelaide University, South Australia, as Lecturer on Accountancy. He has for some time been a Member of the Senate of the University.

Roll of Honour.—Mr. E. J. DUTCH, secretary to Messrs. H. J. Cash & Co., Ltd., electrical and heating engineers, of Westminster, who enlisted in the 2nd King Edward's Horse in August, 1914, and who was twice wounded in 1915, has now been discharged from hospital for the second time, and has been gazetted Second-Lieutenant in the 14th Royal Fusiliers.

Corporal W. J. BOLT, of the 8th Battalion South Staffs. Regiment, who has been killed in his dug-out by a shell whilst asleep, was, until his enlistment, on the staff at the Ocker Hill electrical works, Tipton.

Corporal S. C. PARISH, of the Queen's Surrey Regiment, who was serving his articles at the Croydon Municipal electricity works when he enlisted, has been killed in action. He was 20 years of age.

Lance-Corporal GEO. NASH, of the 10th Battalion Gloucestershire Regiment, who has been killed in France by shell fire, was, prior to his enlistment in October, 1914, on the electrical staff at Norchand Colliery, Lydney.

Trooper OLIVER GOLDSMITH, of the Hampshire Yeomanry, who has died in hospital at Tidworth from septic poisoning set up by an accidental wound to the hand, was, prior to his enlistment last August, on the staff of Messrs. Cooper & Co., electrical engineers, of Bournemouth.

Mr. LEE, late tramway inspector at Colchester, who joined the Royal Army Medical Corps, has been awarded the French Military Medal for conspicuous service in the field. He had just spent a brief furlough at Colchester.

Sergeant-Major DAN HARROP, who was employed as an electrical engineer in the testing room at the Hyde Road tramcar depôt, Manchester, has been promoted to the rank of Second-Lieutenant in the 12th Loyal North Lancashire Regiment for zeal, devotion to duty, and bravery in the field.

Captain ARTHUR B. LAYTON, A.M.I.E.E., who has been gazetted temporary Lieut.-Colonel in the Prince of Wales's Volunteers (South Lancs. Regiment), has been electrical engineer and departmental manager for 13 years past to the firm of Messrs. Joseph Crosfield & Sons, Ltd., Warrington.

Private JONATHAN COOKSON, of the 1st Battalion Lancashire Fusiliers, who was formerly employed at the British Westinghouse Works, Trafford Park, has been wounded in the shoulder, but has now left hospital and returned to the Front.

Sergeant J. BROMILEY, who has just been killed in action in France, was employed by Messrs. Ferranti, Ltd., before he enlisted.

Mr. WM. A. ELLIS, formerly of Northwich (Cheshire), and now an electrician in the Royal Navy, has been awarded the D.S.M.

Lance-Corporal R. BARBER, 1st Cheshire Field Company, Royal Engineers, who was, prior to his enlistment, on the staff of the electricity department of Lever Bros., Ltd., Port Sunlight, has been awarded the D.C.M. On January 15th he visited the works and was presented by Sir Wm. Lever with a gold watch as a memento of his being the first employé of the firm to win the D.C.M.

The County of London Electric Supply Co., Ltd., send us the following information respecting the doings of County men with the Forces:—Mr. H. A. MONCRIEFF, of the secretarial department, who had formerly been serving in France in the "Queen's Westminsters," has obtained a commission as Second-Lieutenant in the 3rd Dorsets. Mr. F. H. HOWELL, of the secretarial department, formerly a bombardier in the 7th County of London, R.F.A., has obtained a commission in the Royal Field Artillery. Mr. N. F. GADSTONE, after service in France, has obtained a commission as Second-Lieutenant in the 4th Essex. Mr. SYDNEY A. KNIGHT, of the secretarial department, after service in France, has been gazetted Second-Lieutenant in the North Somerset Yeomanry. Mr. C. E. SCOTT, of the Putney local office, and serving in the 23rd Middlesex Regiment, has been promoted to Regimental Quartermaster-Sergeant, and is now a Second-class Warrant Officer. Mr. ALAN LEIGH, of the mains department, has been granted a commission as temporary Second-Lieutenant of the 14th Service Battalion East Surrey Regiment. The following employés in the mains department of the company have been killed in action, all of the 9th Battalion Buffs (East Kent): H. BEAZLEY, T. HYAM, and R. REEVES.

Obituary.—Mr. R. F. VENNER.—We regret to record the death, which occurred on Sunday morning last, at the age of 54 years, of Mr. R. F. Venner. The deceased gentleman had been unwell for some time, and his death was not unexpected. Mr. Venner was a son of the late Captain Venner, and he was educated at Malvern College. He was one of the earliest students in the Hammond Electrical Engineering College, now Faraday House, his course beginning there in 1883. He was subsequently with the Hammond Co., and about the year 1886 he took charge of an exhibit of Messrs. Shippey Bros. & Co., at Antwerp. From 1895 to 1897 he was in partnership with his life-long friend, Mr. A. M. Sillar, in the firm of Venner and Sillar. Later the business of Venner & Co., electrical engineers and agents, at Westminster, energetically pushing the sale of Chamberlain & Hookham meters and Venner time switches, brought him into touch with large numbers of our readers. The affairs of that business have been conducted by Mr. E. E. Sharp for several years, and he will continue to conduct them pending the making of new arrangements. Mr. Venner had in recent years been interested in electric signs and in electric heating and cooking apparatus. Failing health, however, interfered with his securing that measure of success which he once anticipated in the cooking apparatus field.

MR. FREDK. JAMES JONES, of the Eastgate, Chester, in business as an electrician and electrical engineer, died on January 19th at the age of 55. He was a native of Dublin, and studied electrical engineering while in New Zealand. Nearly 30 years ago he commenced business at Chester. About three years ago he underwent an operation, and he had been ailing since that time. Mr. G. D. Jones (son) succeeds him in the business.

Wills.—The late Mr. ALFRED BINNS, of Messrs. J. and A. Binns, Ltd., wire manufacturers, Halifax, left £13,101 gross and £9,932 net.

The *Times* states that MONTAGUE HAYES BYTHWAY, R.N.A.S., of Hale, Cheshire, electrical engineer, who died in St. George's Military Hospital, Malta, on active service, left £10,944.

NEW COMPANIES REGISTERED.

F. R. Wade and Co., Ltd. (142,761).—This company was registered on January 19th, with a capital of £1,000 in £1 shares, to take over the business of F. R. Wade & Co., to carry on the business of engineers, manufacturers of electrical instruments and machinery, etc., and to adopt an agreement with F. R. Wade. The subscribers (with one share each) are: F. R. Wade, 95, Colmore Row, Birmingham, consulting engineer; P. W. Wade, Wembley, Stoney Lane, Yardley, Birmingham, engineer. Private company. The number of directors is not to be more than five. F. R. Wade is the first life director. Solicitor: C. Orton, Guildhall Buildings, Navigation Street, Birmingham. Registered by Jordan & Sons, Ltd., 116-117, Chancery Lane, W.C.

General Engineering Co. (King's Cross), Ltd. (142,760).—This company was registered on January 19th, with a capital of £1,000 in £1 shares, to take over the business carried on at 97, Caledonian Road, King's Cross, as the General Engineering Co. and/or A. V. Bond, to carry on the business of scientific and experimental engineers, model and tool makers, smiths, joiners, woodworkers, builders, electricians, electrical, hydraulic and gas engineers, etc. The subscribers (with one share each) are: A. V. Bond, 97, Caledonian Road, King's Cross, N., engineer; H. C. H. Braun, 236, Pentonville Road, N., consulting engineer. Private company. The first directors are A. V. Bond and H. C. H. Braun. Qualification (except first directors), £25. Registered office: 97, Caledonian Road, King's Cross, N.

H. E. Jackson, Ltd. (142,778).—This company was registered on January 20th, with a capital of £2,500 in £1 shares, to take over the engineering business carried on at Churchgate, Leicester, as H. E. Jackson & Co., to carry on the business of ironfounders, mechanical and electrical engineers, electricians, suppliers of electricity for light, heat, motive power, or otherwise, etc., and to adopt an agreement with H. E. Jackson, E. H. Kirk, and C. H. Kirk. The subscribers (with one share each) are: H. E. Jackson, 225, East Park Road, Leicester, mechanical engineer; E. H. Kirk, 106, St. Saviour's Road East, Leicester, manufacturer; C. H. Kirk, High Barn, Letchworth Road, Western Park, Leicester, manufacturer. Private company. The number of directors is not to be less than two or more than five; the first are H. E. Jackson (managing director), E. H. Kirk, and C. H. Kirk (all permanent). Solicitor: B. Wynn Edwards, 33, Friar Lane, Leicester. Registered by Jordan & Sons, Ltd., 116-117, Chancery Lane, W.C.

Shepherd's Parging Block Co., Ltd. (142,756).—This company was registered on January 18th, with a capital of £2,000 in £5 shares, to take over the business of a manufacturer of patent tramrail parging blocks carried on by W. Shepherd at Milkstone, Rochdale, Lancs., as Shepherd's Parging Block Co., together with the benefit of certain existing inventions relating to improvements in connection with the laying of setts with respect to tramway lines or rails and blocks or sections used in connection therewith. The subscribers (with one share each) are: W. Shepherd, Sparthcliffe, Manchester Road, Rochdale, road contractor; Mrs. R. Shepherd, Sparthcliffe, Manchester Road, Rochdale; E. Shepherd, 14, Exeter Street, Rochdale, contractor; H. Shepherd, 36, Hare Street, Rochdale, contractor. Private company. W. Shepherd is first permanent director, subject to holding one-eighth of the ordinary share capital. Registered office: Exeter Street, Milkstone, Rochdale.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Muirhead and Co., Ltd. (82,270).—Capital, £50,000 in £10 shares. Return dated December 29th, 1915. 3,382 shares taken up; £10 per share called up on 382; £3,820 paid; £30,000 considered as paid on 3,000 shares. Mortgages and charges: £13,500.

Larne Electric Light Works, Ltd. (46,962).—Capital, £4,000 in £1 shares (500 5 per cent. cum. pref.). Return dated November 24th, 1915. All shares taken up; £500 paid on the pref.; £3,500 considered as paid on the ord. Mortgages and charges: £2,700.

Enfield Electric Cable Manufacturing Co., Ltd.—Mortgage on certain freehold land at Brimsdown, Enfield, with factory and other buildings, etc., thereon, dated December 31st, 1915, to secure all moneys due or to become due from the company to London County & Westminster Bank, Ltd., not exceeding £10,000.

David Anderson and Co., Ltd.—Issue on January 10th, 1916, of £2,200 debentures, part of a series of which particulars have already been filed.

Keynsham Electric Light and Power Co., Ltd.—A memorandum of satisfaction in full on December 31st, 1915, of third debentures dated December 24th, 1913, securing £1,000, has been filed.

City of Oxford Electric Tramways, Ltd.—A memorandum of satisfaction to the extent of £1,100 on December 17th, 1915, of charge dated February 20th, 1914, securing £46,000, has been filed.

North Wales Power and Traction Co., Ltd.—Particulars of £30,000 debentures, created by resolutions of January 31st, 1912, June 19th, 1913, and June 30th, 1915, filed pursuant to Section 93 (3) of the Companies (Consolidation) Act, 1908, amount of the present issue being £9,000. Property charged: The company's undertaking and property, present and future, including uncalled capital, subject to prior charges. No trustees.

Barbados Electric Supply Corporation, Ltd. (104,367).—Capital, £60,000 in 40,000 pref. and participating and 20,000 ord. shares of £1 each. Return dated November 11th, 1915. 35,172 pref. and 20,000 ord. shares taken up; £34,672 paid on 34,672 pref.; £20,500 considered as paid on 20,000 ord. and 500 pref. Mortgages and charges: £12,500.

Blackpool and Garstang Electric Light Railway Co., Ltd. (62,150).—Capital, £10,000 in £5 shares. Return dated December 31st, 1915. 361 shares taken up; £4 per share called up; £1,707 paid (including £323 received on application for further shares not allotted), leaving £60 calls unpaid. Mortgages and charges: Nil.

Amazon Telegraph Co., Ltd. (44,532).—Capital, £250,000 in £10 shares. Return dated Nov. 30th, 1915. All shares taken up; £250,000 paid. Mortgages and charges: £272,900.

CITY NOTES.

Yorkshire (West Riding) Electric Tramways Co., Ltd.

SIR H. S. LEON presided on January 21st, at 31, Throgmorton Street, E.C., over the annual meeting. He said the revenue for the year amounted to £81,086, against £69,768 in the previous year, but the working expenses were £3,474 more, which equalled a percentage of 10.7 over those of 1914. The percentage of expenses to receipts was 44.25, against 43.72—an increase of .53 per cent. Compared on a car mileage unit basis, the working expenses in 1914 were 4.373d. per car mile, but in 1915 they rose to 4.882d., an increase of a little over ½d. After deducting the working expenses from the gross receipts they had a balance of £45,208, being equal to 55.75 of the gross receipts. The income per car mile was 10.001d. in 1914, and 11.034d. in 1915. The tramway revenue had grown steadily, being £38,051 in 1905, and £81,086 in 1915. The increase in gross income for the year of nearly £7,000 was quite satisfactory, and, so far as they could see, was not due to war conditions, and there was no doubt that they were reaping some of the fruits of the good seed sown in the past. The general increase in expense, however, must be seriously borne in mind, and to what extent it was likely to be permanent he could not say. Under the present abnormal conditions an increase of 11.7 per cent. was not excessive, particularly as they had to pay so much more for wages and for all necessary supplies. As an instance, he might mention that they were now paying 14s. 6d. a ton, instead of 8s. 6d., for a class of coal little, if any, better, and this item alone meant an increase of £2,000. As a result of the year's trading, £45,208 was carried to the net revenue account, and after deducting debenture interest, etc., £29,310 was carried to the appropriation account. To this, £10,725 brought forward from the previous year had to be added, giving a total of £40,035. The board had dealt with this by paying a dividend of 6 per cent. on the cumulative preference shares, which absorbed £12,027; setting aside £5,511 to the depreciation and renewals fund; crediting £2,000 to the insurance fund; by writing off £450 preference shares set aside for the Wood's accident claim; by placing £5,000 to the general reserve fund; and carrying £15,045 forward. He had before fully explained the policy of the board with regard to the substitution of granite setts for the soft granite stone setts, and a considerable amount of the work yet remained to be done as soon as they could get the labour and materials. It had been found necessary to renew the battery at their Castleford power station, and they availed themselves of the opportunity to install a larger one, and had entered into a maintenance agreement with the manufacturers by which 100 per cent. efficiency was guaranteed for ten years. Their capital expenditure was £783,425, £769,810 of which had been expended on lines open for traffic and £13,196 on the Pontefract lighting. They commenced the supply about a month before the war broke out, and there was every prospect of their building up a very good business. The results, even under the present unfavourable conditions, were quite encouraging. No one could say what the conditions in the district they served would be after the war, and the board felt that they must regulate their affairs with due regard to future contingencies. If they were to maintain and improve their services a considerable sum of money must be spent, and the policy of the board was to collect as much money as possible, so that at the earliest date they might be in a position to begin the work and pay cash for it. In the past their relations with the local authorities had been of a most amicable character, but during the past year some of the local councils had pressed them to make considerable modifications in the fares. The general manager and himself saw one of the boards and pointed out the impracticability and financial unsoundness of the requests, and now the local authorities were taking a sort of revenge by raising the road maintenance question. However, the company did not take offence at that, and had met the authorities very reasonably, and it was possible that in due course they would recognise that the company were justified in refusing to lower the fares. Last year he promised that the board would consider if any scheme could be formulated for dealing with the arrears on the 6 per cent. cumulative preference shares, and they had done so, and he hoped a scheme would be prepared when they felt justified in placing one before the shareholders. That moment, however, had not yet arisen. It would be a deplorable thing to put forward a scheme which would be acceptable to the shareholders and then to find that, owing to circumstances entirely beyond their control, they were unable to fulfil the obligations incurred. He asked for the forbearance of the shareholders until the country returned to more normal conditions. In conclusion, the CHAIRMAN referred to the admirable work done by Mr. H. England and the staff.

Mr. G. E. LEON seconded the motion.

Mr. DAVENPORT asked the board if they would accept a resolution to invite Dr. Moody and Mr. Lock to confer with them in regard to dealing with the arrears on the cumulative preference shares, but the CHAIRMAN intimated that he was not prepared to do so, and Mr. DAVENPORT proposed as an amendment that a committee, consisting of Dr. Moody and Mr. Lock, be appointed to meet the board.

After some discussion the amendment was not pressed, and the resolution was carried.

London Underground Railway Meetings.

ON Friday last extraordinary general meetings were held by the Metropolitan District Railway Co., the London Electric Railway Co., the City & South London Railway Co., the Central London Railway Co., and the London General Omnibus Co., at which resolutions were passed sanctioning an agreement between these companies with respect to the application of their receipts and the payment into a common fund of the half-yearly balances after meeting expenses. The Chairman, Lord George Hamilton, said that the agreement was made in pursuance of an Act passed last year. The five companies will afford to each other all reasonable facilities for through passenger traffic, through bookings, through fares, and interchange of traffic. In 1914 the five companies carried 819 million passengers, only 42 millions of whom were through passengers between the systems concerned. The new arrangement would lead to a simple and effective system of through or interchange tickets.

Companies Struck off the Register.—The following have been struck off the register, and are accordingly dissolved:—

Brabbins Fuelless Engine Syndicate.
Budleigh Salterton Electric Light & Power Co.
Economic Coaling Appliance Co.
Emanda Engineering Co.
Power Syndicate of South America.
Russian Wireless Telegraph Trust.
Telenews.
Vacuum Electric and Gas Heating Appliances.
Walker Reversible Turbine Co.

St. James' and Pall Mall Electric Light Co., Ltd.—The directors recommend a balance dividend of 3s. 6d. per share on the 7 per cent. preference shares for the half-year to December 31st, and 4s. 6d. per share on the ordinary, making, with the interim dividend, 8 per cent. for the year, as compared with 10 per cent. for 1914.

Australia.—The Kempsey Electric Light and Power Co., Ltd., in December advertised a prospectus in the Sydney newspapers offering 8,500 £1 shares for issue. The company was to take over the rights, etc., of Kynoch, Ltd., of Sydney, to supply electricity for public and private lighting in Kempsey.

Westminster Electric Supply Corporation, Ltd.—The directors recommend a dividend at the rate of 8 per cent. per annum, less tax, for the half-year ended December 31st (making 7 per cent. for year, as against 9 per cent. for 1914).

STOCKS AND SHARES.

TUESDAY EVENING.

The main interest in Stock Exchange markets is still confined to rubber shares. In that market, the volume of business has taken on a fresh lease of activity; and those people who are intimately connected with it find all their energies taxed to deal with the business that has sprung up. Some part of it, at all events, is mere speculation, in spite of the Treasury regulations to the contrary. The activity has developed into something of a gamble; and, as always happens in such cases, the strength of prices in good companies has brought to light various concerns of doubtful reputation.

The working man spends his money—or so, at least, we are told—upon cheap pianos, amusements, jewellery, furs, putting his war wages into these illusory investments; while the people of a different rank who, especially in the Midlands and

Northern Counties, are making big profits out of the war, are spending their wealth in the purchase of rubber shares, which they can at least justify by the expectation that good dividends will accrue thereon, but which every broker knows are bought in numbers of cases with a view to quick appreciation in capital value.

Meanwhile, the application for Exchequer Bonds goes on steadily, though not to an extent which might reasonably be expected by those who have means for seeing what large amounts are being expended in the purchase of the shares named above. The investment markets remain overshadowed by the Exchequer issue, for the closing of the lists in which no date has yet been officially announced. In the circumstances, it is surprising to find Consols improving; but it is a pleasant surprise, since improvement in Consols spells firmness for all gilt-edged securities, extending beyond debenture stocks to the good-class preference shares in industrial companies.

The electric lighting dividends will be making their appearance before long and there is speculation in the market as to how these will materialise. It is thought that the County of London will maintain its previous distribution, and that the City will follow suit—or, at any rate, make but a small cut in its dividend. But as regards the West End undertakings less certainty is felt; indeed, there are some who think that reduction of one to two per cent. is almost inevitable, in view of the conditions under which the industry has worked during the past six months.

It is pointed out that the fatalities caused by the darkening of London's lights are greater than those which might have been brought about by Zeppelins—a matter of mere speculation, of course; though, having regard to the practical certainty that the Zeppelins would not come in mid-winter, there is point about the complaints which have been raised with reference to the official attitude on the subject. The batch of electric dividend announcements is awaited with a much more general interest than ordinarily—not only by shareholders in these companies, but also by those who have been, and are, hampered and inconvenienced by the lighting restrictions. Chelsea 4 per cent. debenture stock is a little lower, but otherwise there are no changes in the list of quotations this week.

The news from Mexico is read as being unfavourable, and once more there are small falls in the principal bonds of companies working in the country. The reports of American citizens having been murdered gave rise to the assurance that President Wilson would have more work to do in the dictation of notes as dignified as they are vain. Nobody supposes that the United States will trouble about the lives of a few citizens while those of so many thousands of others are being spent in the glorious pursuit of dollars that flow in so readily from the belligerent European countries.

Brazilian Tractions have recovered further; and the market seems to be a better one than it has been for some time past, although the rate of exchange has not helped matters appreciably. Reassurance with reference to the dividend has stiffened the price more than anything else; and a few buying orders which came in at low figures found the supply of shares on offer was quickly exhausted.

The Telegraph market shows more changes. Western Telegraps have risen again, and now stand highest of the trio in which they, with the two Eastern Extensions, command respectful attention from the investor. Eastern Extensions are a shade up. Small rises have occurred in Anglo-American Telegraph stocks. Cuban Submarine preference have been rather pressed for sale, and at 14¼ show 10s. fall.

In the Telephone department, New York Telephone 4½ per cents. are wanted by the Government at 100¾. Sales that are made to the Treasury in connection with the mobilisation scheme are done free of commission, through a broker, the Treasury paying the charges—which, by the way, are half those which the Stock Exchange Committee officially permits its members to make. Chili Telephones are ⅜ down at 6½; and United River Plates have eased off to 5⅞. Some of the 4 per cent. debenture stocks in this department are lowered to 79, at which the return on the money is about £5 1s. per cent.

Babcock & Wilcox have risen 5s. to 2 11/16, on persistent buying based upon reports that the company is making excellent progress, and that it will have big profits to divide, after making allowance for the excess tax and all possible reserves. British Westinghouse preference have gone back. The dividend in their case is due very soon. Last year 3s. was paid—that is to say, 7½ per cent., the shares being of the nominal value of £2 each. It is expected that they will get 10 per cent. this year. Edison & Swan fell 1s. to 7s. 6d.; but Electric Constructions continue to creep up, and are again 6d. to the good at 15s.

Marconis are a slightly duller market, and interest has again subsided for the time being. The American shares, which rose to 18s. 6d., reacted to 17s. on a general fall of securities in America, due mainly to the difficulties in Mexico. Canadian Marconis, after touching 7s. 9d., lost the pence; and the activity that was stirred lasted but a few days.

Rubber shares are holding their prices with marked tenacity; and although the quotation for the raw stuff gives no particular indication of rising again to 4s. 3d., at which it stood a fortnight ago, the reports and dividends now being published are sufficiently good to keep alive interest and to encourage fresh buying in this department.

SHARE LIST OF ELECTRICAL COMPANIES.

	Dividend, 1914.	Price Jan. 25, 1916.	Rise or fall this week.	Yield p.c.
HOME ELECTRICITY COMPANIES.				
Brompton Ordinary	10	7½	—	£3 18 4
do. 7 per cent. Pref.	7	7	—	5 0 0
Charing Cross Ordinary	5	3½	—	7 2 10
do. do. 4½ Pref.	4½	3½	—	6 0 0
do. do. City Pref.	4½	3	—	7 10 0
do. 4 Deb.	4	75	–3	5 6 8
Chelsea	5	4	—	6 5 0
do. 4½ Deb.	4½	87	—	5 3 6
City of London	9	12½	—	7 7 3
do. do. 6 per cent. Pref.	6	11	—	5 9 1
do. do. 5 Deb.	5	98	—	5 2 0
do. do. 4½ Deb.	4½	85	—	5 6 0
County of London	7	10	—	7 0 0
do. do. 6 per cent. Pref.	6	10½	—	5 17 3
do. do. 1st Deb.	4½	85	—	5 5 0
do. do. 2nd Deb.	4½	88	—	5 8 0
Kensington Ordinary	9	6	—	7 10 0
London Electric	4	1⅛	—	8 8 4
do. do. 6 per cent. Pref.	6	4½	—	7 1 2
do. do. 4 Deb.	4	75	—	5 4 0
Metropolitan	8½	2½	—	7 15 7
do. 4½ per cent. Pref.	4½	8	—	7 10 0
do. 4½ Deb.	4½	85	—	5 6 0
do. 5½ Deb.	5½	70	—	5 0 0
St. James' and Pall Mall	10	6	—	8 6 8
do. do. do. 7 per cent. Pref.	7	8	—	8 16 8
do. do. do. 5½ Deb.	5½	70	—	5 0 0
South London	5	2⅜	—	7 5 6
South Metropolitan Pref.	7	1 1/16	—	6 14 0
Westminster Ordinary	9	6	—	7 10 0
do. 4½ Pref.	4½	4	—	5 12 6
TELEGRAPHS AND TELEPHONES.				
Anglo-Am. Tel. Pref.	6	99½	+ ¼	6 1 0
do. Def.	33/6	21¾	+ ⅛	7 14 3
Chile Telephone	6	6⅜	— ⅛	6 10 8
Cuba Sub. Ord.	5	7¼	— ¼	6 9 0
do. Pref.	10	14¼	— ⅝	6 18 0
Eastern Extension	7	128 xd	+ ⅛	*6 7 0
do. 4 Deb.	4	79	–1	5 1 0
Eastern Tel. Ord.	7	127½ xd	—	*6 5 0
do. 8½ Pref.	8½	64½	–1½	5 8 6
do. 4 Deb.	4	79	–2	5 1 0
Globe Tel. and T. Ord.	6	10⅜	—	*6 12 2
do. Pref.	6	10½	—	5 17 1
Gt. Northern Tel.	22	33⅝	+ ½	6 10 4
Indo-European	13	49	—	6 15 4
Marconi	5	1 15/16	—	5 8 1
New York Tel. 4½	4½	100¾	+ ¾	4 9 1
Oriental Telephone Ord.	10	1½	—	5 6 8
do. Pref.	6	⅜	—	6 17 2
Tel. Egypt Deb.	4½	80	—	5 0 0
United R. Plate Tel.	8	5⅞	— ⅛	*7 19 0
do. Pref.	5	4⅝	—	5 8 1
West India and Pan.	1	1⅛	—	8 17 9
Western Telegraph	7	12⅝	+ ⅛	*6 4 6
do. 4 Deb.	4	79 xd	—	5 1 0
HOME RAILS.				
Central London, Ord. Assented	4	70	—	5 14 4
Metropolitan	1½	25½	—	4 18 0
do. District	Nil	13½	— 1	Nil
Underground Electric Ordinary	Nil	1⅝	—	Nil
do do. "A"	Nil	6/6	—	Nil
do. do. Income	6	8¾	+ 1	*8 5 3
FOREIGN TRAMS, &c.				
Adelaide Sup. 6 per cent. Pref.	6	6	—	6 0 0
do 5 Deb.	5	98	—	5 5 0
Anglo-Arg. Trams, First Pref.	6½	4⅜	—	6 13 6
do. 2nd Pref.	6½	5⅜	—	8 3 0
do. 4 Deb.	4	71	— ½	5 12 8
do. 4½ Deb.	4½	77	—	5 17 0
do. 5 Deb.	5	80½	—	6 4 0
Brazil Tractions	8½	52½	+1½	6 12 8
Bombay Electric Pref.	6	10½	—	5 17 1
do. 4½ Deb.	4½	85	—	5 3 0
British Columbia Elec. Rly. Pfce.	5	59 xd	—	8 9 6
do. do. Preferred	—	40	—	Nil
do. do. Deferred	—	35	—	Nil
do. Deb.	4½	64	—	6 12 10
Mexico Trams	Nil	39	—	Nil
do. 5 per cent. Bonds	—	46	–1	Nil
do. 6 per cent. Bonds	—	59	–1	Nil
Mexican Light Common	Nil	29	—	Nil
do. Pref.	Nil	18	—	Nil
do. 1st Bonds	—	47	—	—
MANUFACTURING COMPANIES.				
Babcock & Wilcox	14	2 11/16	+ ⅛	5 4 1
British Aluminium Ord.	5	22/6	—	4 9 0
do. Pref.	6	18/-	—	6 13 4
British Insulated Ord.	15	10½	—	7 2 10
do. Pref.	6	5½	—	5 11 7
British Westinghouse Pref.	7½	44/3	–9d.	6 16 4
do. 4 Deb.	4	69	—	5 14 10
do. 6 p. lien	6	101	—	5 19 0
Callenders	15	11⅛	—	6 13 4
do. 5 Pref.	5	4½	—	5 17 8
do. 4½ Deb.	4½	90	—	5 0 0
Castner-Kellner	20	F½	—	6 8 0
Edison & Swan, £3 pd.	Nil	7/6	–1/-	Nil
do. do. fully paid	Nil	1	—	Nil
do. do. 4 Deb.	4	60	—	6 13 4
do. do. 5 % Deb.	5	60	—	8 6 8
Electric Construction	6	15/-	+6d.	8 0 0
do. Pref.	7	1	—	7 0 0
Gen. Elec. Pref.	6	9½	—	6 8 1
Henley	20	13½	—	*8 12 6
do. 4½ Pref.	4½	4½	—	5 6 0
do. 4½ Deb.	4½	92	—	4 17 9
India-Rubber	10	9½	—	*12 19 0
Telegraph Con.	20	85	—	*7 16 6

*Allowance made for dividends being paid free of income-tax.

L.C.C. Loan Interest Rate.—The Finance Committee of the L.C.C. has decided that until further notice the rate of interest to be charged by the Council for loans to local authorities shall be 5 per cent.

EXPORTS AND IMPORTS OF ELECTRICAL GOODS DURING DECEMBER, 1915.

THE December return of electrical exports and imports marks the close of a year which will be noteworthy for many years to come. For some time the monthly statements indicated a continuous improvement in electrical export business, but the December total of £349,409 shows a considerable falling away from the high level of the preceding month, £522 059. The electrical imports showed a similar, though less marked, tendency, the total for December £238,691 comparing with £250,343 in November. The re-exports were valued at £24,382, as compared with £30,560 in November.

A glance through the various sections of the exports shows that the falling off in values was wide-spread, and most conspicuous in cables, telegraphic material, and machinery exports. On the other hand, both machinery and cable imports were on an extended scale in December, and this also applies to imports of lamps and parts which reached nearly £30,000 in value. Telegraphic and telephonic imports were practically halved, and battery and carbon imports also fell off in value.

The Australian Commonwealth, New Zealand, and India were all good markets during the month, the former being credited with as high values as during pre-war days.

To France also we supplied considerable material. American electrical imports fell off by some £30,000, as compared with November, while Dutch imports included over £20,000 worth of lamps and parts.

Registered Exports of British and Irish Electrical Goods from the United Kingdom.

Destination of exports and country consigning imports	Electrical goods and appliances.	Wires and cables rubber and other insulations.	Electric lighting fittings and accessories.	Electric glow lamps.	Electric arc lamps and lamp parts.	Electric meters and instruments.	Electric machinery.	Electrically-driven machinery.	Batteries and accumulators.	Carbons.	Telephonic cable and apparatus and electric bells.	Telegraphic cable and apparatus.	Total.
	£	£	£	£	£	£	£	£	£	£	£	£	£
Russia, Sweden, Norway and Denmark ...	2,976	3,362	150	270	3,065	914	11,239	...	2,080	456	1,298	396	26,206
German West Africa	...	33	...	3	...	...	...	...	...	...	55	...	91
Netherlands, Java and Dutch Indies ...	241	10,752	377	116	6	34	1,530	16	243	255	338	1,675	15,583
Belgian Congo	8	4	...	6	...	...	8	...	...	...	...	...	26
France	1,785	153	474	177	144	648	8,003	752	960	299	2,652	7,832	23,879
Portugal	358	125	53	139	...	111	192	20	...	9	222	176	1,405
Spain, Canary Isles and Spanish N. Africa...	166	5	52	96	27	651	3,179	90	249	110	72	2,044	6,741
Switzerland, Italy and Austria-Hungary ...	...	110	142	4	...	13	2,202	184	418	43	93	7,492	10,701
Greece, Roumania, Turkey and Bulgaria ...	12	38	6	7	...	6	...	...	11	...	5	...	85
Channel Isles, Gibraltar, Malta and Cyprus...	128	137	103	62	...	...	3,283	...	22	3	34	506	4,278
U.S.A., Philippines and Cuba	264	...	74	16	...	10	2,303	...	2	...	...	48	2,717
Canada and Newfoundland	305	513	22	423	7	966	821	7	114	45	...	24	3,247
British West Indies and British Guiana ...	184	88	155	65	12	24	129	7	45	15	2	82	808
Mexico and Central America	6	5	11	9	...	5	...	7	34	3	186	345	611
Peru and Uruguay	35	581	19	20	...	16	58	2,030	8	15	...	37	2,819
Chile	51	737	143	192	...	708	75	1,053	97	2	4,243	180	7,481
Brazil	81	199	150	422	213	...	194	716	174	4	...	195	2,348
Argentina	596	5,947	1,087	145	93	463	2,250	3,099	564	20	870	179	15,313
Colombia, Venezuela, Ecuador and Bolivia...	96	39	29	143	...	249	490	13	2	...	272	110	1,353
Egypt, Tunis and Morocco	121	776	56	18	7	18	1,093	90	133	13	112	3,470	5,907
British West Africa	169	94	22	91	16	20	154	...	41	14	156	495	1,272
Rhodesia, O.R.C. and Transvaal	456	777	600	1,593	...	31	260	105	1,280	23	8	8	5,141
Cape of Good Hope	968	3,507	75	85	...	191	2,625	6	731	48	788	607	9,631
Natal	24	453	142	35	...	...	4,823	59	45	...	...	237	5,818
Zanzibar, Brit. E. Africa, Mauritius & Aden	391	128	8	64	...	32	425	12	49	25	52	64	1,250
Azores, Madeira and Portuguese Africa ...	62	125	7	3	...	...	533	...	50	5	...	18	803
French African Colonies and Madagascar ...	34	19	13	5	...	...	...	...	...	16	...	90	177
China and Siam	426	506	912	77	21	991	553	17	206	23	438	638	4,808
Japan and Korea	3,292	23	18	5	259	463	2,462	173	126	21	...	1,100	7,942
India	1,539	10,572	4,829	1,156	22	1,874	15,036	1,992	3,398	98	3,155	2,144	45,815
Ceylon	60	423	299	140	...	68	18	3	28	...	75	37	1,151
Straits Settlements, Fed. Malay States and Sarawak	812	702	66	113	12	34	125	237	323	20	184	284	2,412
Hong Kong	76	6,437	352	113	24	266	1,306	398	3	8	154	170	9,307
West Australia	113	974	576	1,196	...	1,416	71	464	274	193	96	...	5,373
South Australia	84	1,010	77	2	5	3	928	...	243	3	526	87	2,968
Victoria	4,943	15,493	2,666	698	...	500	19,101	...	923	1	3,151	330	47,806
New South Wales	1,161	12,039	607	857	61	1,552	2,507	6	394	40	60	1,503	20,787
Queensland	102	213	368	366	...	317	271	...	22	145	910	27	2,741
Tasmania	10	278	...	...	5	9	40	...	6	...	33	8	389
New Zealand and Fiji Islands	986	6,863	1,615	1,814	136	6	5,881	269	2,472	...	21,673	504	42,219
Total, £	22,621	84,240	16,355	10,746	4,135	12,609	94,078	11,825	15,770	1,975	41,913	33,142	349,409

Registered Imports into the United Kingdom of Electrical Goods from all Countries.

Russia, Norway, Sweden and Denmark ...	...	806	104	310	476	...	17,772	12,411	1,169	855	2,357	36,260
Germany	...	...	...	...	...	...	...	...	...	...	...	...
Holland...	...	1,913	229	16,741	1,328	...	125	...	807	...	...	22,143
Belgium	...	...	...	...	...	...	810	...	...	...	...	840
France	420	84	...	1,994	264	713	386	...	8,353	2,990	244	15,448
Switzerland	1,683	...	805	340	9	4,314	1,401	...	575	109	180	9,416
Italy	40	4,464	...	...	...	...	310	645	...	...	...	5,459
Austria-Hungary	...	...	...	...	...	...	...	...	...	...	...	...
United States	9,309	4,863	4,335	4,654	2,480	569	41,790	49,150	10,278	5,942	13,889	147,259
Total, £	11,452	12,130	5,473	24,039	5,557	5,596	62,624	62,206	21,182	9,896	16,670	236,825

Additional imports.—Spain, carbons, £374 ; Japan, flash lamps, £97 ; Canada, electrical goods, £432 ; wires, £390 ; telephone and telegraph apparatus, £573.

Registered Re-Exports of Foreign and Colonial Electrical Goods from the United Kingdom.

Various countries, mainly as above... ...	2,814	8,916	...	2,856	11	60	2,130	...	319	578	6,698	24,382

TOTAL EXPORTS : £349,409 TOTAL RE-EXPORTS : £24,382 TOTAL IMPORTS : £238,691

NOTE.—The amounts appearing under the several headings are classified according to the Customs returns. The first and third columns contain many amounts relating to "goods" otherwise unclassified, the latter, doubtless, consisting of similar materials to those appearing in adjacent columns. Imports are credited to the country whence consigned, which is not necessarily the country of origin.

ELECTRICAL EXPORTS AND IMPORTS DURING 1915 AND PREVIOUS YEARS.

SINCE the year 1909 it has been the practice of the ELECTRICAL REVIEW, at the commencement of the year, to publish a graphic summary, showing the value month by month of the British electrical exports and imports during the last and previous years, the curves of values being based on the monthly statistics which are a regular feature of this journal.

The steady progress which had, on the whole, characterised both branches of business—but particularly the exports—for some years, was brought to an abrupt conclusion with the opening of the great European war in the beginning of August, 1914, the immediate effects of which were discussed in our last yearly summary,* and strikingly indicated by the curves of business for the preceding 12 months.

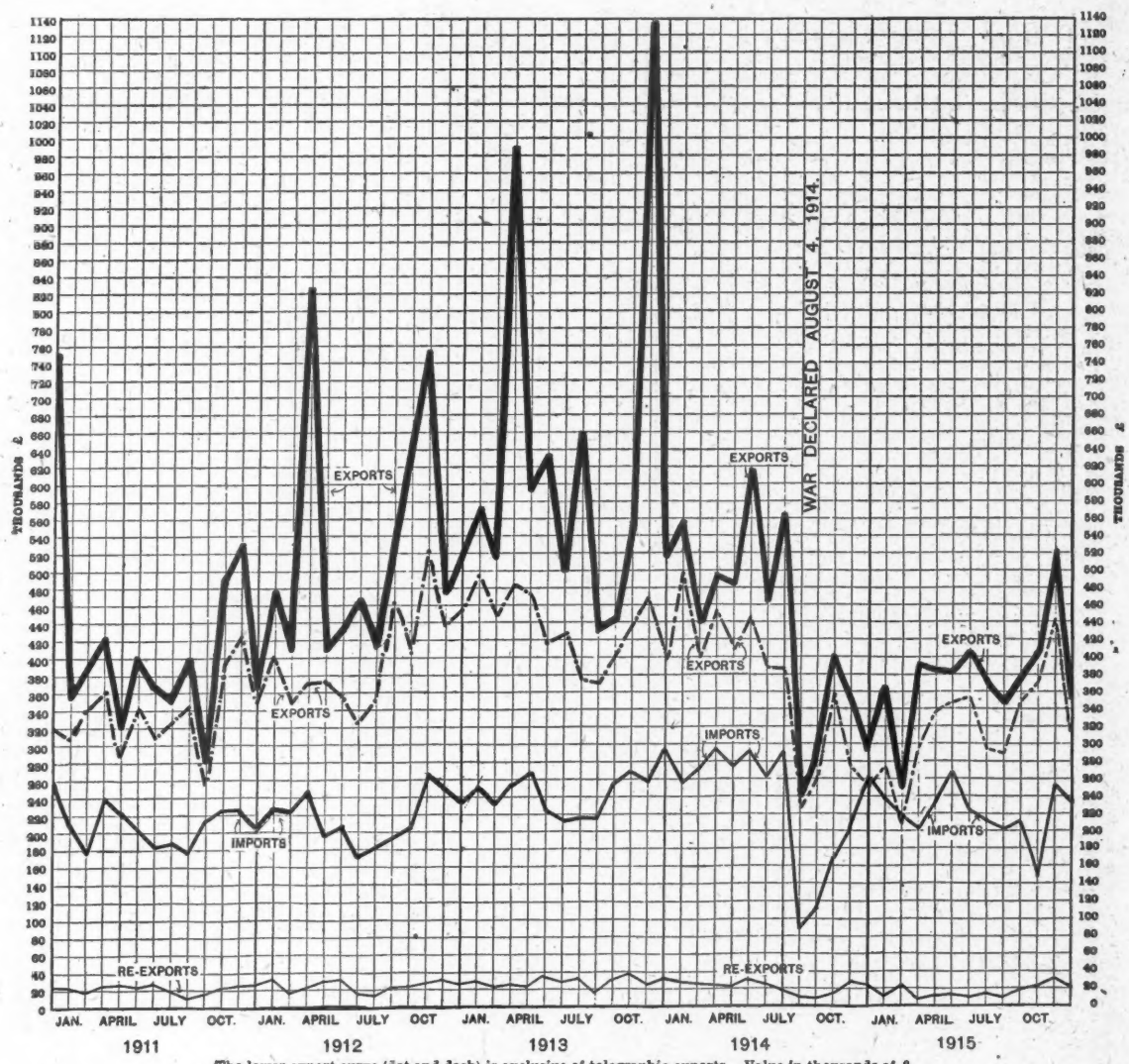
fact that despite the war this section of our export trade was but little inferior to that of 1911.

It will be a matter of interest to many and satisfaction to most that the electrical imports curve, on the whole, shows a declining tendency, after the rapid recovery to almost normal values at the end of 1914.

The re-export curve shows the depressed condition of this class of business—in any case of small amount—during the greater part of the year, pre-war values being reached only during the last two months.

The gross values of our electrical exports and of the telegraphic material included therein for the period covered by the curves shown in fig. 1, were as follows:—

1911	...	Gross	£4,600,000	Telegraphic	£560,000
1912	...	,,	6,300,000	,,	1,500,000
1913	...	,,	7,568,000	,,	2 388,000
1914	...	,,	5,189,000	,,	835,800
1915	...	,,	4,564,000	,,	690,300



The lower export curve (dot and dash) is exclusive of telegraphic exports. Value in thousands of £.

FIG. 1.—CHART SHOWING MONTHLY ELECTRICAL EXPORTS AND IMPORTS DURING THE PAST FIVE YEARS.

Since that time the British nation, and indeed the British Empire as a whole, as well as practically the whole of industrial Europe, has been engaged in a war of ever-increasing magnitude, which has more or less involved the concentration of the entire financial and industrial resources of the countries concerned on war measures, to the exclusion almost of normal trade. Moreover, the financial dislocation of Europe has affected the purchasing power of probably every commercial country in the world, and to this can be added the very pressing difficulties of shipping—the conditions, in fact, being extremely unfavourable to overseas engineering trade of any kind. It is therefore with satisfaction that we can point to the unlooked-for steady expansion of electrical export business during the past 12 months of war, as shown by the two upper curves in fig. 1. Although the extreme fluctuations in telegraphic export values which characterised former years were absent in 1915, yet a steady business remained, and a comparison of the electrical export business (with and without telegraphic exports) of the year, with previous years, reveals the

These figures represent a monthly average of general business—as shown by the dot-and-dash curve, for 1911, of £338,000; 1912, £400,000; 1913, £432,000; 1914, £363,000; and 1915, £323,000. It should be noted that during the first half of 1914 export values were at a high level.

The total value of electrical material imported into this country during 1915, according to our published returns, was £2,646,000, as compared with £2,767,000 in the previous year, and £2 946,500 in 1913; these figures represent monthly averages for the three years referred to of £220,500, £230,000 and £245,500 respectively, showing that a steady falling-off has occurred during this period, despite the preoccupation of home manufacturers.

The re-exports languished during the greater part of the year, reaching a total value of only £198,800, and a monthly average of £16,500, which compares badly even with the £265,200 total and monthly average of £22,000 in 1914, when the first effects of war were felt.

Fig. 2 shows the trend of values in two of the most important sections of the exports—viz., machinery and cables.

Business in the former exhibited a fluctuating tendency

* ELECTRICAL REVIEW, January 29th, 1915, pp. 158-161.

and the position shows but little recovery since the outbreak of war. The cable exports, on the other hand, have shown a remarkable recovery, under the circumstances, and in falling away to insignificant proportions during the early part of the year, recovered normal values in November, while lamp imports have steadily increased in value over the 12 months.

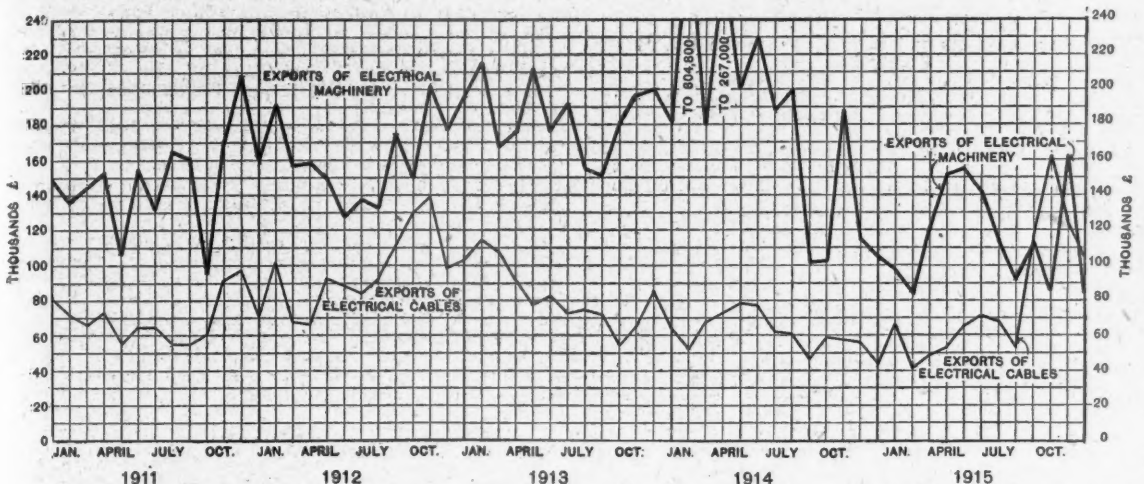


FIG. 2.—MONTHLY EXPORTS OF ELECTRICAL MACHINERY AND ELECTRICAL CABLE—OTHER THAN TELEGRAPHIC AND TELEPHONIC CABLE—DURING THE PAST FIVE YEARS.

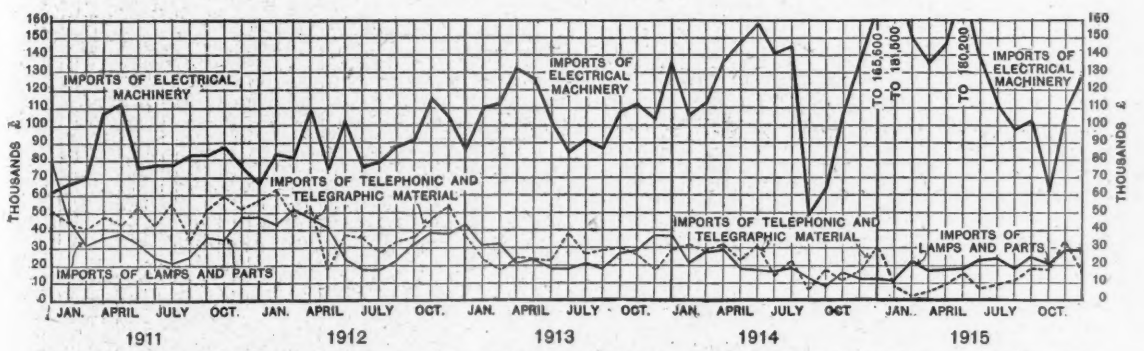


FIG. 3.—MONTHLY IMPORTS OF ELECTRICAL MACHINERY, TELEGRAPHIC AND TELEPHONIC MATERIAL AND CABLE, AND ELECTRIC LAMPS AND PARTS DURING THE PAST FIVE YEARS.

November last reached a record total, only approached on one former occasion, in 1912. Taken over the whole year, the machinery exports reached a total value of £1,482,000, as against £2,154,000 in the previous year; while the cable exports, exclusive of telegraphic and telephonic cable, which are included in their own sections, were valued at £916,000, as compared with £741,000 in 1914.

Turning to the imports curves shown in fig. 3, it will be seen that the machinery imports reached record values in January and May, but during the latter half of the year values fell off rapidly. The importation of telegraphic and telephonic material, after

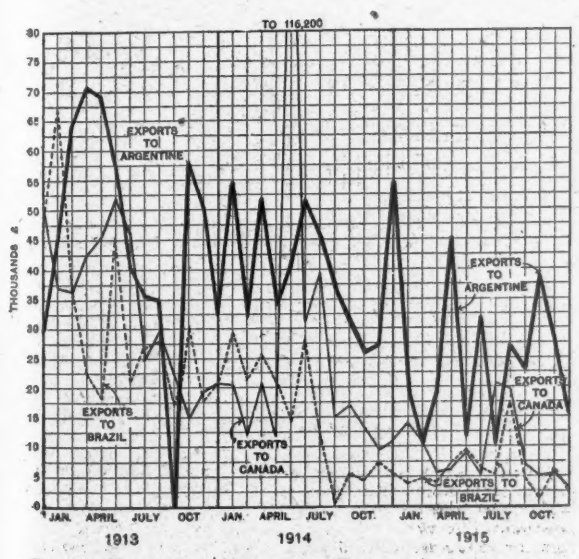
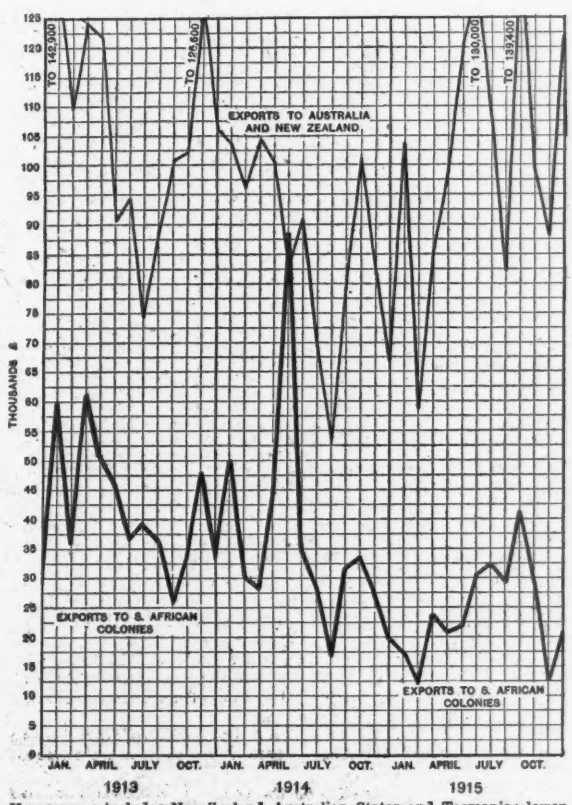


FIG. 4.—ELECTRICAL EXPORTS TO CANADA, ARGENTINA AND BRAZIL, 1913-15.



Upper curve includes New Zealand, Australian States and Tasmania; lower curve includes Cape, Natal, Transvaal, Orange River Province and Rhodesia.

FIG. 5.—ELECTRICAL EXPORTS TO AUSTRALASIA AND SOUTH AFRICA, 1913-15.

Electrical machinery imports totalled £1,543,000 in value, imports of telegraphic and telephonic material amounted to £154,600, and of lamps and parts to £256 600, during the year; these figures comparing with £1,476,000, £267 500 and £215,000 respectively for the same branches of business in 1914.

Purchasing Countries and Importers into the United Kingdom.

Of the remaining countries shown in figs. 4 to 7, the first three, showing the course of business with what are ordinarily some of our principal overseas customers, will be viewed with interest.

Fig. 4 indicates that our Argentine business has been falling off since March, 1913, and this process has been to some extent accelerated in 1915, while both Canadian and Brazilian business has

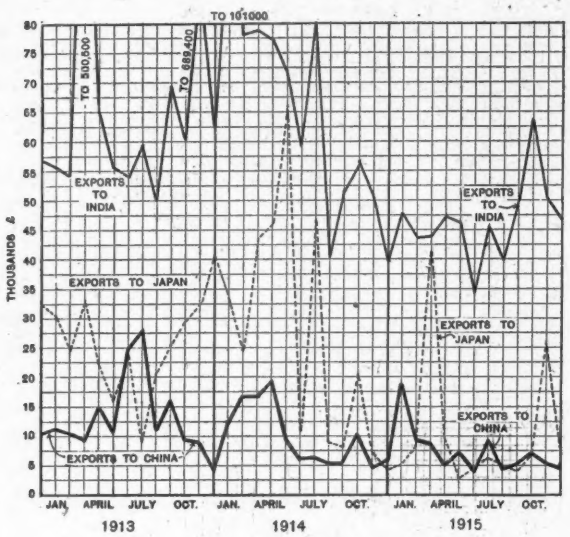


FIG. 6.—ELECTRICAL EXPORTS TO JAPAN, INDIA AND CHINA, 1913 15.

slumped since the war, a position which one would expect, knowing the conditions that exist, particularly in Canada.

Turning to fig. 5, our Australian and New Zealand electrical exports represent the one bright feature of these curves, business in these directions at least being normal; the South African business, also shown in fig. 5, had an improving tendency for many months, but fell away to a low figure towards the end of the year.

Fig. 6, dealing with Far Eastern business, shows that our electrical exports to India only began to show signs of recovery from the effects of the war in the last month or two of the year, while Japanese business, with the exception of one or two spasmodic revivals, remained at a low ebb throughout the year, being in fact exceeded in some months by business with China, a country in which, so far as we are concerned, electrical trade expectations appear to be accompanied by progressively disappointing results. The gross values of our export business to the countries above mentioned for the years 1913 (before the war), 1914 and 1915 (in which the full effects of the war were felt) were as follows:—

	1913.	1914.	1915.
	£	£	£
India	1,769,000	784,000	557,000
Australia and New Zealand	1,283,000	1,032,000	1,234,000
Argentina ...	558,000	448,000	279,000
South Africa ...	508,000	434,000	293,000
Canada	392,000	318 000	112,000
Japan	309,000	320,000	128 000
Brazil	350,000	176,000	73,000
China	159,000	117,000	88,000

One of the effects of the war has been considerably to increase the to-and-fro electrical trade between this country and neutral and allied countries of Europe. Thus our electrical exports to France during 1914 were valued at over £150,000, while in 1915 they rose to £321 000; the monthly average for the first six months of 1914, before the war, £17,700, compares with £26,700, the corresponding average for the whole of last year.

In a similar manner our export business with the Scandinavian countries and Russia for 1914 amounted to £253,000, but only reached a total of £110,000 and a monthly average of £18,300 during the first half of the year, while for the year 1915 a total of £465,000, and a monthly average of £38 800, are recorded, Russia being a preponderating purchaser, no doubt for military reasons, as was probably the case with France.

Our last curve, fig. 7, shows that during 1915 the United States more than equalled Germany before the war as an electrical importer into this country.

That this would probably be the case was indicated in our last annual summary, when her unique position as the only really free manufacturing nation in the world, able to undertake exporting, was mentioned.

French imports into this country, which were naturally hard hit when war broke out, have made an excellent recovery to a position, if anything, better than they were in before the war, while Belgian imports are, of course, practically unrecorded—only four items occurring during the year, having a total value of £1,600.

The total value of electrical material entering this country from the United States during 1915, according to our returns, was £1,855,000, an average of £155,000 a month, representing twice the value of the corresponding business in 1914, during the first six months of which, however, German electrical imports into this country reached record proportions. These figures are, of course, in excess of normal German imports before the war, which during 1913, for instance, were valued at £1,632,000, or a monthly average of £136,000. From our ally, France, we received £167,000 worth of electrical material, or rather more than in 1914, when the total was £122,000.

Apart from the countries above mentioned, the neutral countries of Europe—Sweden, Norway, Denmark, Holland and Switzerland imported a greater value of electrical material into this country during last year than in 1914. In the case of Sweden, Norway and Denmark together, this business was valued at £180,000, as against £166,000 for the previous year. Dutch electrical imports reached a total value of £153,000, as compared with only £60,000 in 1914, and a considerably less amount in 1913; while Swiss electrical imports were also valued at £153,000, as against only £88,000 in 1914.

The greater part of the Dutch imports represent lamps and parts, of which during the year some £125,000 worth entered this

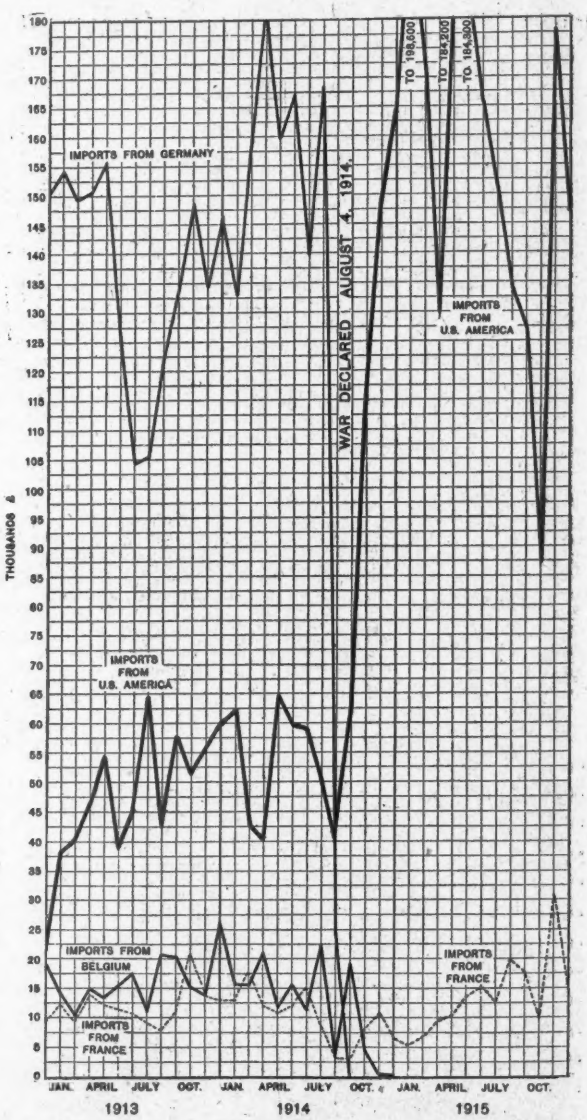


FIG. 7.—ELECTRICAL IMPORTS FROM GERMANY, U.S.A., BELGIUM AND FRANCE, 1913-15.

country; in other words, we have been buying over £10,000 worth of lamps per month from Holland during the last year, as compared with £1,400 worth before the war.

General.—In view of the adverse circumstances which prevailed throughout the whole of 1905, the marked revival of our electrical export business was a most welcome, and, we confess, unlooked-for feature of the year, in connection with which, however, it must be

remembered that relative values show a considerable increase on pre-war days. Of the future it is difficult to say anything; but as it appears that despite the intensive development of munition making and concentration on war work, the British electrical industry possesses a sufficient surplus manufacturing capacity to enable it to make a very effective bid for overseas, as distinct from European war business, there is some ground for hoping that the present year will not compare unfavourably with 1915, so far as export business is concerned. The strong position of the American electrical importer into this country, in the absence of effective European competition, was, of course, foreseen; what the effect of this may be after the war is an interesting speculation, especially if it should happen that an adverse tariff handicaps German efforts in this country. For the present, however, there is little doubt that the Americans will retain their position as importers.

THE PREDETERMINATION OF THE PERFORMANCE OF DYNAMO-ELECTRIC MACHINERY.

PROF. MILES WALKER'S paper was read before the BIRMINGHAM LOCAL SECTION of the INSTITUTION OF ELECTRICAL ENGINEERS, on January 12th. An abstract of the paper appeared in our last issue.

Mr. R. ORSETTICH said that Prof. Walker's calculation sheet was the shortest he had ever seen; in his opinion it was cut down too far. He also thought the design sheets should be drawn up to include results of tests. Some reference should have been made in the paper to observations of temperature rises by means of detectors, as information on this subject was of great importance.

Prof. G. KAPP said that he had suspected for a long time that a flat cooling slot was not satisfactory. He found that the conduction across a group of laminations was about 100 times less than along the laminations, hence the cooling along a radial slot was not much good. A tube cutting across the laminations was more satisfactory.

Mr. W. MARDEN said that probably the more correct criterion for deciding if the thermal limit of the frame size had been reached, would be the product of A_g B and J_a Z_a, a term proportional to the output per revolution, though this also would not be constant where a large range of speed was covered on the same frame. The ratio of the magnetic loading to the current loading would also differ when for convenience the same frame was used both as a synchronous generator and an asynchronous motor, due to the necessary change in magnetising characteristics. The advantage of the author's calculation sheet over the methods in which the flux per pole was dealt with was not marked, since in this case also it was usual to employ as a guide the value either of the total armature current turns per centimetre periphery, or the figure for this value corresponding to the particular pole pitch. His constant K_t was a combination of various factors, each of which could be separately influenced by changes of design. The fact that the actual value did not change largely for a given type, direct-current generator, alternator, or asynchronous motor, was perhaps fortunate, but it was better to keep well in view each of the separate factors that were subject to change.

Mr. R. G. JAKEMAN said that in calculating the magnetising current of induction motors as shown, Prof. Walker advocated the use of the maximum flux density. It was well known, however, that if the field-form constant, K_f, was taken the same throughout, this method gave entirely wrong results if there was high saturation in the magnetic circuit. Hence it was necessary to take a different value of K_f (the ratio of the mean density to the maximum) according to the amount of saturation. It was his experience, however, that the method published by Dr. Kloss and Dr. Smith, which, considered the density one-third of the way along the pole pitch instead of in the middle, gave excellent results for the magnetising current, and was entirely independent of the saturation in determining the flux density in the teeth of an alternator or direct-current machine. It seemed to him quite as easy to estimate the virtual number of teeth per pole, as to estimate the value of K_f, since the latter could not be worked out in each case.

The paper was also read and discussed by the INSTITUTION OF ELECTRICAL ENGINEERS in London on January 13th.

PROF. S. P. THOMPSON, in opening the discussion, expressed appreciation of the valuable material contained in the paper. It seemed possible to be too minute in calculation in view of the practical limits with which they had to deal, but it was necessary to have the theory well in hand. He agreed with the author's summary of practical design methods, which could not be better stated. The empirical formula KW/R.P.M. = $d^2 l$, brought before the Institution some 30 years previously by Mr. Esson, and based on experiments with machines of different size, speed and output, was found to be scientifically correct, with the addition of a suitable constant. The author had shown how to build up graphically the curve of electromotive force for any single conductor which the rotor pole was passing, and this had been done in another way for years. But whatever method was adopted, the important point was the working result. The author's arithmetical method of finding, for a distributed winding, the E.M.F. form which results from a pole field form of particular shape, simplified the old graphical method of plotting a number of identical displaced curves along a base line and finding from them a resultant wave form. He doubted whether it was wise to use the same machine schedule for all types of machine; it would probably be better to use a schedule for each type.

MR. EVEREST said the author had divided his subject into four parts. He urged the value of uniformity of calculation methods, which was desirable, but he (the speaker) thought impossible until the professors agreed to adopt identical methods, including formulæ and symbols. As a rule, it was necessary now to translate from one to another, and much time was lost in finding what it was all about. There seemed to be no reason why symbols should have different meanings in so many cases, as one had to think what they meant. He felt it was really not advisable, from the point of view of the design office, to use a single calculation sheet for a number of different machines. The essential characteristics of a machine should appear prominently, as also any factors assisting to produce them; it was a mistake to combine several coefficients in one expression. The author compared the advantages of using maximum air gap density as against total pole flux as a basis of design, and he (the speaker) preferred the latter, as also the mean density across the total pole pitch, which enabled them to obtain the magnetic loading. As regarded cooling with narrow ducts, he suggested that the cooling value of a duct was really determined by the ratio of the surface to the cross-section.

MR. H. BURGE said designers of electrical machines were still worried by limits set by engineers to current density in armature and field windings; the author, however, made no reference to this in connection with temperature rise. A good deal could be said for the proposal to boil down the E.M.F. formula to one standard form for all types of machines, but he did not agree with it.

MR. HAWKINS agreed that almost all classes of machines could be designed on similar lines, and that it might be advantageous to use one design-sheet, simply from the facility gained by using the same method; he did agree that much would be gained by comparing the quantities of different types of machines on one sheet. The author had advanced strong arguments for retaining the maximum value of B_g in an expression of the fundamental E.M.F. equation, based on the total flux, one reason being the ease with which maximum flux density on the teeth could be calculated, but it had its drawbacks.

DR. S. P. SMITH was glad the author had suggested that they should arrive at some common method of designing machines, and wished the paper had been confined to that only. He proceeded to show that Esson's expression for the output of a machine gave them the relation between the two methods referred to by the author.

MR. H. ROTTENBURG asked whether the Institution could not arrange to collect a list of symbols in use and publish them in parallel columns, so as to bring home the absurdity of the present situation.

PROF. WALKER briefly referred to one or two points raised, but reserved his reply to the discussion.

THE DESIGN OF HIGH-PRESSURE DISTRIBUTION SYSTEMS.

The paper by Mr. J. R. Beard was discussed at a meeting of the SCOTTISH LOCAL SECTION OF THE INSTITUTION OF ELECTRICAL ENGINEERS, in Glasgow, on January 11th.

Mr. A. PAGE (Glasgow), noting that Mr. Beard advised that the area to be served should be as large as possible, recalled that Mr. Lackie, in his presidential address to the Institution of Shipbuilders and Engineers last year, said that, in his opinion, the supply for the whole of Scotland could be best undertaken from three power stations. In connection with the cost of sub-stations, in Glasgow they were employing girls as switchgear attendants and finding them do the work very satisfactorily. In his remarks on switchgear, Mr. Beard again confirmed that the load which had to be carried had really very little to do with the design—the gear must be capable of dealing with a heavy short-circuit current. Far too much shoddy sub-station switchgear had been installed. Dealing with the economical section of mains, Mr. Page said that in Glasgow they seldom took into consideration the exact requirements of a small consumer. They had standard sizes of cables, and one was selected which might have little relation to the immediate load, but was laid down for flexibility and future development in the way of sub-stations or public works *en route*. He had worked out for Glasgow the following figures corresponding to those given by Mr. Beard in his paper:—Pressure actually adopted, 6,600 volts; number of switches per mile of main, 2.78; average max. kilovolt-amps. per mile of main, 1,000; most economical voltage, 8,000, *i.e.*, 1,400 above the voltage which Glasgow was actually employing. Sooner or later they must go to higher voltages if they were going to deal with heavier loads.

Mr. WHYSALL (Greenock) expressed the opinion that protective gears of the balanced type were extremely effective and satisfactory in operation. In Manchester it meant the addition of another current transformer and a relay, but nothing more was needed in many cases. The Merz-Price gear was extremely satisfactory, and one was particularly interested in

this type because of the possibility of applying it to systems which were already in existence, and had been designed without any thought of protection such as was desired to-day.

The CHAIRMAN (Mr. D. A. STARR) said his impressions a few years ago were that overhead lines were more subject to breakdown than underground cables, but his subsequent experience with more than 50 miles of 11,000-volt overhead transmission had been sufficient to satisfy him that when overhead lines were well designed and regularly patrolled they were as reliable as underground cables, particularly in Renfrewshire and Lanarkshire, where they were subject to subsidences. With a good complete balanced protective gear they had not had any trouble for a long time. Wayleaves had been the cause of much trouble in the south, but if the proprietors were judiciously approached, much more satisfactory results might be achieved. He could not see the necessity of making switchgear absolutely fault proof.

Mr. W. W. LACKIE (Glasgow) said there was a similarity between the system advocated by the author and the Glasgow low-tension network. They had made a practice for many years of laying down a definite size of network in each street, irrespective of the immediate demands, and as the load grew in any particular district they laid a new feeder to a point mid-way between two adjacent feeders. The system of interconnecting extra-high-tension mains had only been rendered possible by the work of Messrs. Merz, Price, and Hunter. The main switches should be of the very best design, as they had to stand enormous strains. In Glasgow the problem was rather different from that discussed in the paper, as they were dealing with sub-stations each containing between 5,000 and 6,000 KW. of plant, which necessitated at least one feeder to each sub-station.

Mr. BEARD, in the course of his reply, said that air cushions and vent pipes on switches were of little good apart from the fact that a vent pipe took away gases from switches and made it safe to operate switches for the second time; otherwise, owing to gas hanging about, the switch might be damaged at the second closing. His opinion had been confirmed that earthing feeders formed the cause of innumerable mistakes in pulling out the wrong feeder, and the danger to employés in this direction was a serious one. Some of the interlocking arrangements which had come out lately were not very complicated. In taking the cost of the distribution system, he took two-thirds of the fixed charges, and not two-thirds of the cost. The regulation of wattless current and load between the power stations on the system he had shown was carried out by the whole operation being centred in one man named the "system engineer," who told the various stations the load to run at and the wattless current they had to run on—the wattless and governing machines being adjusted accordingly. Between the sub-stations the load factors were kept by ammeters, and in a few cases where it had been found advisable some form of adjustment bus-bar had been installed. He thought on the whole working, however, the number in use at present was about a dozen. This was not a very serious problem, and in many cases they were only operated at 20,000 volts, though in some systems now being laid out a higher voltage would be adopted. The balanced current system which he referred to in the paper was the Merz-Price system, and he dealt with the balance protective gear which one got by connecting three transformers together. Most people had two with the main earth leakage protection. They had used this much for tail ends, and also had adopted it to transformer protection to make it more sensitive to faults to earth. It was only suitable for tail-ends, however, and did not detect faults between phases, which, of course, were most important on big systems. In Newcastle, overhead mains were found not too reliable, although very great attention had been paid to them. He understood that in South Wales where, like Mr. Starr's district, they were troubled with subsidences, cable faults were three or four times as numerous as those upon the North-East Coast system. The wayleave question was one which had brought about pretty general trouble, but he understood the Institution purposed taking some action as soon as things returned to normal. He could not agree that America was now in the front with switchgear. There were certain cases of small lighting distribution where they had put in automatic control which kept the voltage constant on the sub-stations. These gave perfect satisfaction, but for the power supplies the need did not arise, for the H.T. voltage could quite readily be kept within reasonable limits.

ELECTRIC HEATING.

Mr. S. WILKINSON'S paper on "Electric Heating: Its Present Position and Future Development," was discussed at a meeting of the SCOTTISH LOCAL SECTION of the INSTITUTION OF ELECTRICAL ENGINEERS in Edinburgh on December 14th, 1915. An abstract of the paper was given in our issue of December 24th, p. 828.

Mr. WEAVING said he had carried out a number of experiments which confirmed the opinion that a high loading was economical, and with the aid of a thermostat still higher loadings might be used and still further economy effected. Previous thermostats, while they might look after the temperature of the atmosphere, required a great deal of attention themselves. The thermometer and breaker described in the paper were very simple and, speaking from experience, seemed reliable. He had found it to break with ease 30 watts at 200 volts. Manufactured in quantities, the apparatus should be inexpensive. The principal feature of Mr. Wilkinson's thermostat was that it dispensed with a battery. As a result of experiments, he (Mr. Weaving) had found that for heating purposes electricity at ½d. per unit was equal to gas at 2s. 3d. per 1,000 cu. ft. The large proportion of electric fires sold as compared with lamp radiators left no doubt in his mind as to which would be the survivor.

Mr. W. W. LACKIE (Glasgow) said that the principal recommendation in favour of the electric radiator was that it could be placed exactly in the position where the heat was wanted. The author gave some figures showing the quantity of electric power necessary to heat a room, viz., 1½ to 2 watts per cu. ft. While this amount might be necessary to heat a large area, there were many places where less would do. For instance, in a dining room of 3,600 cu. ft. he found a radiator taking one unit per hour placed under the dining-room table, give as good results as a big coal fire. In November, 1914, the Glasgow Corporation rented premises for the administration of the Prince of Wales Relief Fund, and the electricity department were called upon to supply the necessary heating. The principal apartment was 60 ft. x 36 ft. x 12 ft. high, having a total capacity of 25,000 cu. ft. By arranging the radiators alongside individual desks, ample heating was found to be provided by the installation of radiators taking a total of 10 KW. The premises were occupied for practically a year, and the consumption of energy was 17,000 units, which at ½d. per unit gave a bill of £55, or a return of £5 10s. per KW. It was generally admitted that radiators should give off a large percentage of radiant heat. A captain on a 4,000-ton tramp steamer had a 4-element 1,000-watt dull radiator fitted in his cabin, and complained of feeling cold with an air temperature of 67 deg. F. Two of the 250-watt elements were removed and replaced by one radiant element taking 230 watts; with an air temperature of 57 deg. F. he said: "Now we are nice and warm!" That was to say, 730 watts gave him more satisfaction than 1,000 watts did. The Glasgow Corporation opened a showroom about three months ago, and in the first ten weeks that showroom sold 450 pieces of electrical apparatus representing 752 KW., whilst contractors and firms who dealt in such appliances stated that increased custom had been traced to advice given by the showroom staff. In a Glasgow suburb called Dumbreck, eight villas had been equipped electrically throughout. The size of these houses varied from 7,000 cb. ft. to 12,000 cb. ft., and each house had 10 to 12 KW. of heating appliances, including water heating. The largest consumption for any one of the houses for the year ending May, 1915, was 14,000 units, giving a bill of £40; in other cases the annual consumption was only half of this. Speaking broadly, however, the consumption of electrical energy in a house might be anything from 10 to 50 times what it would be if lighting only were taken. These eight villas were all on one main. The aggregate maximum demand, taken on one of the recent very cold days in November, was only 17 KW., which gave a diversity factor of 5 on the total of 80 KW. installed. This was practically the same diversity factor as they had in lighting. In Glasgow they had 10,000 domestic consumers, and 2,500 of these had heating appliances of some kind; their total consumption for lighting was 500,000 units, and for other purposes, 1,000,000 units. A large number of street lavatories in Glasgow had water heaters installed, taking from 3 to 10 KW. each. The annual bill for these varied from £7 to £30 per annum, depending on the size of lavatory, and they had had no complaint about the cost nor serious trouble with the apparatus. Mr. Goslin, the electrical engineer to the Glasgow Corporation Tramways Department, had given some very valuable information with regard to the electrical heating of the head office of the department. They had had electric heating installed for ten years. At first a hot-water system was installed, but it was found unsuitable owing to the various hours' work in the different offices. Mr. Goslin had found that the question of electric heating was bound up with the question of ventilation. Where heating was adequate without the accompanying provision of ventilation, complaints were soon heard of dry throat and other forms of discomfort and irritation. Mr. Goslin's conclusions, briefly, were that with thermostatic control the saving might be anything from 43 to 87 per cent.; without thermostatic control he found a room heated to a temperature of 74 deg. F., whereas with automatic control the temperature was kept between 59 deg. and 60 deg. F. Mr. Goslin had carried out a very comprehensive experiment in a test room where he had 36 thermostats scattered throughout the room at different heights. He found that there was as much as 10 deg. difference of temperature between a place near the ceiling and one near the floor level; also that there was a difference of 5 deg. between the temperature near a window and that of an adjacent wall. This pointed to the fact that the thermostat must be very carefully placed in a room. He also established the very practical fact that one watt-hour raised 100 cu. ft. of air 1 deg. F. Mr. Goslin recommended large low-temperature heaters and automatic air regulators.

Mr. R. ROBERTSON (Glasgow) contended that the industry got a big set-back some years ago by the installation of radiators much too small for the work they were put to. Mr.

Wilkinson's minimum figure of 1½ watts per cu. ft. to be heated was very nearly correct. In making up data in an experiment similar to that of Mr. Wilkinson's, he was struck with the divergent results obtained in different rooms due to the position of doors, windows, fireplaces, etc., some rooms requiring as much as 25 per cent. more than others per cubic foot. He agreed that the best results were to be obtained by the installation of a small luminous radiator for cheerful effect and a large controlled radiator for temperature rise and maintenance. For the thermostat and circuit-breaker, as outlined by Mr. Wilkinson, to be a success, one would require to be installed in each room of a house. If a saving of anything approaching 75 per cent. could be got, as in the case of gas, a case was clearly made out for thermostatic control, and any extra capital cost would be more than justified.

In replying, Mr. WILKINSON said that the thermostat could be made suitable for the regulation of temperatures in water or in ovens. It was marvellous what results could be obtained when a radiator was properly placed and controlled. The figures given by Mr. Lackie as to the sales from his showroom proved conclusively the soundness of the business policy in opening such an establishment. The cost of the thermostat was 52s. 6d., with 2s. 6d. for the resistance. What was wanted for domestic heating was a large black heat convector and a small luminous radiator.

AMERICA AND FOREIGN TRADE.

THE Chief of the Bureau of Foreign and Domestic Commerce, U.S.A., Dr. E. E. PRATT, has recently issued his first report. According to the official summary of this statement published at Washington, Dr. Pratt says that the European war has suddenly thrust before the eyes and imagination of the American business community the subject of foreign trade. A large part of the report is devoted to a discussion of commercial conditions brought about by the war and to constructive suggestions for further extensions of American trade abroad.

After describing in detail the growth of U.S. foreign trade during the first twelve months of the war, Dr. Pratt asserts that the American business community should guard against any sense of safety in their present prosperity in so far as that prosperity is based on business connected with the belligerent activities in Europe. He warns business men to carefully discount the continuance of so-called war orders and avoid basing future calculations upon conditions which they bring into existence. Two of the great problems that must be solved if the United States is to make the most of its present opportunities receive much attention in the report, namely, financing foreign trade, and the problem of educating men to carry on such trade.

In spite of the fact that Americans are making headway in financing their foreign trade the report insists that they can never hope to gain the really big prizes in foreign trade until they are prepared to loan capital to foreign nations and to foreign enterprises. "The big prizes in foreign trade are the public and private developments of large proportions, as, for example, the building of railroads, the construction of public-service plant, the improvement of harbours and docks, the digging of canals, and many others which demand capital in large amounts. New countries are generally poor. They look to older and richer countries to supply them with the capital to make their improvements and to develop their resources. The country which furnishes the capital usually sells the materials and does the work. In the last analysis it comes to this: The country that wants the business must finance the purchases, since the improvements will be made and the materials paid for out of the money loaned."

The other problem of commanding importance in the development of U.S. international commerce is the education of men for foreign trade. "It is absolutely necessary that we train men to carry on our foreign trade, for we find ourselves to-day without an adequate supply. This problem may be regarded as the very fundamental of success in this field. Our banks cannot establish branches because they have not the men with which to man them. Our manufacturers find it difficult to secure salesmen. Our investors cannot find competent advisers on foreign offerings."

The report takes up such questions as the necessity of a definite foreign commercial policy for the United States, the revision of commercial treaties, the much-discussed subject of a merchant marine, co-operation in foreign selling, free ports, and commercial preparedness. It is stated that the effectiveness of the Bureau's work in promoting American trade in foreign countries is best shown in the definite practical results obtained. To prove that such results have been well worth while, the report takes up in detail a number of the largest contracts that American firms have closed as a result of the Bureau's activities. Perhaps the largest order of this kind resulted from placing representatives of a Russian concern in touch with American exporters of raw cotton. One of these exporters reports that it has closed a five-year contract for 40,000 bales of cotton annually, which will amount to two or three million dollars annually, or between ten and fifteen million dollars during the life of the contract. The report continues:—

"We are also informed of four other specific instances of orders, each one of which amounted to a million dollars or more, the information concerning which was first published in our foreign trade opportunity service. These are: A railroad for the island of Formosa; a coal-handling plant for the port of Durban, South Africa; battleships for a South American republic; and arsenal machinery for the arsenal at Hang Yang, China.

"Recently we were informed by a large milling concern in the West that a little over two years ago they formed a business connection with a concern in Turkey. The name of this concern had been obtained from the Bureau. During the past two years the amount of business done with this one concern has amounted to over $800,000.

"Numerous instances have come to our attention where the results in each instance have been smaller, but nevertheless important. For example, information published on foreign trade opportunities resulted in a contract for a new telephone system for Bergen, Norway, amounting to $201,000; a contract for a petroleum pipe line at Bucharest, Roumania; a contract for the construction of the capitol of Taihoku, Formosa."

As a result of a conference with the King of Spain, a commercial attaché of the Bureau opened up markets for about 3,000,000 tons of American coal annually. This conference resulted in the removal of the Spanish transport tax on American coal that had previously been a great obstacle to gaining a foothold in this market. Dr. Pratt calls special attention to the new and important commercial-attaché service made possible by an appropriation of $100,000 by the Sixty-third Congress, and urges that a still greater expansion of the Bureau's work abroad is imperative under present conditions and under the conditions sure to exist in the future.

FOREIGN AND COLONIAL TARIFFS ON ELECTRICAL GOODS.

AMENDMENTS.

SWEDEN.—Exportation of the following articles has been prohibited: Copper (manufactured or raw) refined from raw material (not from scrap) at a Swedish factory; nickel scrap, cast anodes of nickel even if provided with ears with or without hole; nickel wares, viz., sheets and hoops, rods, nails and rivets, also bolts, pipes and tubes, wire and wire cloth.

SWITZERLAND.—The Board of Trade has been informed that the Société Suisse de Surveillance Economique at Berne began operations on November 16th. The electrical and similar articles of which the Society will take delivery, and for which it will in future be the only authorised consignee in Switzerland, are enumerated in the accompanying list. These articles can only be consigned to the Society if its written consent has first been obtained by the ultimate consignee. Consequently, no export or transit licences will be granted in respect of such articles unless the application is accompanied by the document proving the consent of the Society. Articles destined for Switzerland from the United Kingdom, France, Italy, and Russia in respect of which export licences have been granted or conditionally authorised before November 16th, and articles from neutral countries in respect of which transit permits have been similarly granted, may be exported or allowed to pass in transit without being consigned to the Society, in virtue of the special guarantees already given by the Swiss importers. All applications to the War Trade Department for licences which have not yet been favourably considered or conditionally authorised should be renewed, and accompanied by the document proving the consent of the Society. The following are among the articles referred to:—

Accumulators, electric, and accumulator glasses.
Aluminium in all forms and aluminium manufactures.
Asbestos, crude and manufactured.
Cable, insulated.
Celluloid, raw, in bulk, sheets, rods, tubes, clippings and waste.
Detonators.
Electrical firelighters.
Electrical carbons.
Electrical insulated wire and cables.
Electrodes, piles, and component parts.
Graphite.
Instruments, nautical, observation, geodetical, and optical.
Machine tools and parts thereof.
Machinery for use in marine and aerial navigation.
Machinery, electrical, electric dynamos, and motors.
Magnetos.
Mica, rough and worked.
Rubber, vulcanised, in sheets.
Surgical instruments and apparatus, including rubber gloves.
Telegraphs, material for.
Tungsten in all forms.
Vehicles of all kinds used in military or naval transport.

MOROCCO.—With reference to the prohibition of the importation of enemy goods into the French zone, the Board of

Trade understand that certificates of origin are required for all goods imported into that zone, and that so far as British goods are concerned the authorities will accept certificates issued by Chambers of Commerce in the United Kingdom if drawn up in the form which is accepted by the French Customs authorities in the case of certificates issued by Chambers of Commerce in respect of certain goods for which they are required in France. The signature of the issuing authority must, however, be legalised by the local French Consular Officer.

URUGUAY.—A Degree, dated September 13th, lays down regulations respecting certificates of origin in respect of goods shipped to the Republic of Uruguay. The Decree provides as follows:—

Article 1.—The Uruguayan Consular Agents are authorised to issue—when requested to do so—certificates of origin and nationality in respect of goods destined to be imported into the Republic of Uruguay.

Article 2.—The certificates must be presented in duplicate to the Consular Agents, must be drawn up in Spanish or in French, must be signed by the consignor of the goods, and must indicate the marks, numbers, and quantity of the packages, the nature of the receptacles, the nature of the goods, the gross weight, the origin or nationality of the goods, name of the consignee (in the case of goods not declared "to order"), and the ports of shipment and of destination. Each certificate may relate to only one consignor and consignee.

Article 3.—The Uruguayan Consul at the port of shipment may also issue certificates of origin for goods to be shipped with the option of being unloaded at either a foreign or Uruguayan port, provided the goods are consigned to a firm established in Uruguay.

Article 4.—Consular Agents shall *viser* certificates of origin, return the duplicate to the consignor of the goods, and send the original at once to the Uruguayan Consul at the port of shipment, informing the consignor that the duplicate should be transmitted to the respective shipping agent at that port, in order that the agent may present it, together with the respective manifests, bills of lading or "parcel-receipt," to the Uruguayan Consul there. The Consul shall make the necessary verifications, affix the original of the certificate of origin to the copy of the bill of lading or "parcel-receipt," which is to be delivered to the master of the vessel, and shall send the duplicate certificate, along with the other documents required by the Uruguayan Consular Regulations, to the Customs Department at Montevideo.

Article 5.—The Consul at the port of shipment, after checking the certificates of origin from the shipping documents, shall note on both (the original and the duplicate) the name of the ship on which the goods were loaded.

Article 6.—In the case of goods sent by parcels post, the duplicate of the certificate shall be sent to the Customs Department at Montevideo and the original returned to the interested party in order that it may be attached to the postal dispatch note.

Article 7.—Consular Agents shall charge the following fees for the visa of certificates of origin or nationalisation of goods, viz.:—

For the visa of each certificate in respect of goods to be accompanied by bill of lading or "parcel-receipt"	1 peso.
For the visa of each certificate in respect of goods to be sent by parcel post	20 centavos.

NEW PATENTS APPLIED FOR, 1916.

(NOT YET PUBLISHED).

Compiled expressly for this journal by MESSRS. W. P. THOMPSON & Co., Electrical Patent Agents, 285, High Holborn, London, W.C., and at Liverpool and Bradford.

412. "Switching devices for starting internal-combustion engines." R. BOSCH (firm of). January 10th.

417. "Telephone transmitters or microphones." INTERNATIONAL ELECTRIC Co. & R. G. LE NOIR. January 10th.

425. "Electrical heating apparatus." H. BURGESS and A. H. TAYLOR. January 11th.

436. "Magneto-ignition devices." G. R. SALT. January 11th.

440. "Means for applying electrical treatment." A. VERNON-WARD. January 11th.

455. "Apparatus for the external shaping of clay in the manufacture of telegraph insulators, etc." H. L. DOULTON & W. PODMORE. January 11th.

465. "Electric rotary converters." BRITISH THOMSON-HOUSTON Co. & F. P. WHITAKER. January 11th.

469. "Electro-magnetic therapeutic apparatus." E. BACHELET. January 11th.

471. "Electrical condensers." C. S. FRANKLIN & MARCONI'S WIRELESS TELEGRAPH Co. January 11th.

483. "Electric hand-lamps." H. BIGGLESTON. January 11th.

487. "Magnet systems for magneto-electric machines for ignition purposes in internal-combustion engines." W. SCHMIDT. January 11th.

492. "Electric arc lamps." H. T. HARRISON. January 11th.

494. "Telegraphs." W. D. KILROY. January 11th.

503. "Cable clamps for electric wiring installations." G. S. BOOTHROYD AND CALLENDER'S CABLE & CONSTRUCTION Co. January 12th.

519. "Secondary batteries." G. PEARSON. January 12th.

541. "Ignition dynamos." C. T. MASON. January 12th.

572. "Electric street pillar-boxes, etc." BRITISH INSULATED & HELSBY CABLES, LTD., & B. WELBOURN. January 13th.

577. "Lamp-shade for electric lamps." L. A. PRIESTLEY. January 13th.

579. "Dynamo-electric machinery." J. MOULD. January 13th.

581. "Electrical apparatus for producing hot and cold currents of air for drying hair, etc." E. B. WRIGHT. January 13th.

599. "Radio-receiving circuits." C. J. CLOSE. January 13th.

622. "Electric cigar-lighting outfit." R. K. HEARN. January 14th.

640. "Electric heating element, and method of making same." W. H. LEWERS & B. A. TAFF. January 14th.

660. "Galvanic eyeglasses and spectacles." T. CARR. January 15th.

661. "Electric motor starters and controllers." E. SCHATTNER, T. G. TRAVIS, & J. R. WALTON. January 15th.

665. "Machines for making electric cables, etc." MACINTOSH CABLE Co. AND P. W. SANKEY. January 15th.

679. "Mountings for electric switches." H. E. MITCHELL. January 15th.

681. "Alternating-current electric apparatus." BRITISH THOMSON-HOUSTON Co. & P. C. WHITAKER. January 15th.

PUBLISHED SPECIFICATIONS.

1914.

24,792. INDUCTION MOTOR METERS. W. Hamilton & Ferranti, Ltd. December 30th.

24,837. ALTERNATING-CURRENT DYNAMO-ELECTRIC MACHINES ADAPTED FOR SYNCHRONOUS WORKING. L. J. Hunt & Sandycroft, Ltd. December 31st.

24,838. DYNAMO-ELECTRIC MACHINES. L. J. Hunt & Sandycroft, Ltd. December 31st.

24,839. ALTERNATING-CURRENT DYNAMO-ELECTRIC MACHINES. December 31st. L. J. Hunt & Sandycroft, Ltd. December 31st.

1915.

41. FLUID FLOW MEASURING DEVICES. British Thomson-Houston Co. (General Electric Co., U.S.A.). January 6th.

130. MAGNETO-ELECTRIC MACHINES. R. B. North & A. M. Allen. January 4th.

491. SYSTEMS OF ELECTRIC MOTOR CONTROL AND CONTROLLERS THEREFOR. British Thomson-Houston Co. (General Electric Co., U.S.A.). January 12th.

723. STRAY-WAVE PROTECTION DEVICES FOR ELECTRIC CIRCUITS. Siemens Schuckertwerke Ges. January 16th. (June 17th, 1914. Patent of addition not granted.)

2,344. BONDING CONNECTOR FOR BONDING THE ARMOURING OF ELECTRIC CABLES. C. J. Beaver & E. A. Claremont. February 13th.

2,570. MEANS FOR PROTECTING AND INDICATING THE CONDITION OF ELECTRIC CIRCUITS. F. S. Grogan & the British Electric Transformer Co., Ltd. February 17th.

6,685. COIN-OPERATED ELECTRIC SUPPLY APPARATUS. P. Wessel. May 4th. (May 4th, 1914.)

6,997. DYNAMO-ELECTRIC MACHINERY. Siemens Schuckertwerke Ges. May 10th. (May 11th, 1914.)

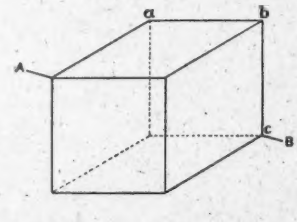
7,923. SLOT-CLOSING DEVICES FOR DYNAMO-ELECTRIC MACHINERY. Siemens Schuckertwerke Ges. May 28th. (May 30th, 1914.)

9,386. CASINGS FOR ELECTRICITY METERS. W. Hamilton & Ferranti, Ltd. June 26th. (Divided application on 24,792/14, December 30th.)

10,231. VIBRATORS FOR INDUCTION COILS AND THE LIKE. A. E. Beattie. July 14th.

10,676. ALTERNATING-CURRENT AMPERE-HOUR ELECTRICITY METERS. Landis and Gyr, Akt. Ges. July 22nd. (July 22nd, 1914.)

Two Interesting Problems.—The *Wireless World* recently propounded the following problem, which had been set to an advanced class of electrical engineers in a well-known college in Liverpool":—"Consider the cube to be constructed of a series of wires representing the edges—*i.e.*, *a* to *b* = one wire, *b* to *c* is



another, &c. Each has a resistance of 1 ohm. What is the total resistance A to B? If, instead of being constructed of a series of wires, the cube were made of sheet metal, each side having 1 ohm resistance, what would be the resistance between A and B?"

Another little problem presented by our contemporary is the following:—"Given two steel rods exactly alike in appearance, you are told that one is a magnet. How would you tell which piece was the magnet if you had nothing with which to suspend the rods, no point to poise the rods upon, no other pieces of iron or steel to attract, and no instruments of any kind?" This problem was submitted by Electrician H. Christie, R.M. of H.M.S. *Bonaventure*.

Both problems are puzzling at first sight, but yield to simple methods of attack.